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GAS LIGHT JOURNAL

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Correspondence.—Wishing to make this Journal a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of these subjects a pleasure or a profession.

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THE SOUTH METROPOLITAN COMPANY OF LONDON

We give below, in a condensed form, the figures of the last half year's business of this large company. The price at which their gas is sold is 2s. 10d., or about 70 cents; and we would call especial attention to the different items of receipts that appear in the report, which may serve to indicate how the price of gas can be so low. Out of a total of receipts of about two million dollars, one-half a million of dollars is received for residuals; this is sufficient to pay for repairs, wages, salaries, any purification in gas manufacture and leave over $100,000 towards the cost of coal.

Again, the distribution and management expenses, taken together, amount to $151,251 for 2,000 millions of gas, or about seven and a-half cents per thousand feet.

Capital.

Stock authorized	$13,410,000
Loans "	3,800,000
	$17,210,000

Of the above amount about $300,000 remains on hand as yet unissued.

Receipts.

Gas at 70 cents per thousand	$1,213,896	
Gas for public lighting	125,688	
		$1,339,584
Residuals—		
Coke	301,573	
Breeze	2,093	
Tar	114,181	
Ammoniacal liquor	115,313	
Ammoniated superphosphate	8,528	
		$541,688
Meter rents		29,205
Rents receivable		7,708
Total receipts		$1,918,185

Expenditures.

Gas Manufacture—		
Coal	$664,170	
Purification	30,735	
Salaries	29,150	
Wages	142,930	
Repairs of works and plant	195,450	
		$1,062,435
Distribution—		
Repairs and maintenance of mains	39,010	
Salaries and wages	26,745	
Repairs and renewal of meters	20,790	
		$86,545
Management charges—		
Directors fees	9,250	
Salaries	20,505	
Collectors' commissions	22,075	
Stationery and general charges	12,876	
		$64,706
Lighting and repairing public lamps		27,556
Taxes, gas referees, auditors, etc		64,154
Law and Parliamentary charges		8,588
Bad debts		10,155
Pensions, workingmens' sick fund, etc		6,466
Total expenditures		$1,330,605
Gross profit for half year		$ 587,580

The company has a reserve fund, a renewal fund and an insurance fund, which together amount to $1,132,715, accumulated from past profits, which are available to secure the stockholder's dividends.

During the half-year 205,372 tons coal were carbonized, and 2,040 millions of gas were made. This company supplies gas to 13,540 public lamps. The

increase in the send out, when compared with the corresponding part of last year, was a little over four per cent. The publication of just such information as this we believe would be a good principle for gas companies to adopt in this country. It would disarm criticism where only a fair manufacturer's profit was made by any company; and where more than a fair profit is made it would undoubtedly have a tendency to reduce the price of gas to a fair basis, the result of which would be a large ultimate increase of business, which would, in time, lead to further reductions in price.

The majority of people are reasonable enough when satisfied that they are treated fairly; and if they were shown that the profits of a gas company were less in per cent. than those of other manufacturing companies, and less, also, than those of the butcher, grocer, drygoods dealer, etc., much of the unreasonable howl about monopoly would cease forever.

THE ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

The XIIth Annual Meeting of this Association was held in Boston on the 15th, 16th and 17th ult., and was a very successful affair. The attendance was large, and, besides the regular members, there were representatives from the various parts of the United States. The President's address was short, but practical and to the point. Two excellent papers were read which elicited a very free and full discussion. Besides the regular papers, which it is to be regretted were so few in number, there were discussions upon various topics of immediate interest to the members. It is to be hoped that the practice of having carefully prepared papers in abundance will not be allowed to fall into disuse. The benefit to be derived therefrom is much greater than that from a random discussion upon unannounced topics which, of necessity, must be dealt with in too much of a general way. A most delightful banquet was served on the afternoon of the second day, and upon the third day many of the members availed themselves of the opportunity of visting the works in Boston and vicinity. The general verdict seemed to be that the meeting was a most satisfactory one.

Volume III. of King's Treatise.

The Third Volume of this most valuable work is now ready for distribution. The issue has been delayed, until all the numbers were completed, because different authors were treating of the different subjects at the same time, and the extent of the work could not be fully determined until all had finished.

The three parts of Volume III. treat of "Consumption of Gas," "Treatment of Residual Products," and miscellaneous subjects such as "Rating of Gas Companies," "Manufacture of Illuminating Gas from other Substances than Coal," and "Gas Generator Furnaces," and is divided into 13 chapters. The price of the entire Volume III. will be eight dollars and eighty cents, to be sent in sheets, so that those having the previous numbers can bind these in uniformity therewith. In the case of those who have subscribed to the previous numbers the price will be eight dollars and twenty cents; but we must request all those ordering the Volume III. to enclose, with the order, either draft or money-order for the amount of the subscription. Orders should be sent to this office as early as possible.

[Official Notice.]

The Western Gas Association

Secy's Office, Western Gas Association,
110 Vine St., St. Louis, Mo., Feb. 21, 1882.

The Fifth Annual Meeting of the Western Gas Association will be held at the Grand Pacific Hotel, Chicago, Ills., on the 10th, 11th and 12th days of May, 1882. A full attendance is requested, as matters of great interest will be presented at the Meeting.

Lee A. Hall, *Secretary.*
Thos. Butterworth, *President.*

Changes.

The following changes in management of various gas works are announced:

Manchester, N. H.—Mr. Warren retires on April 1st, and is succeeded by Mr. L. P. Gerould, of Watertown and Newton gas light company.

Springfield, Mass.—Mr. George Dwight is succeeded by Mr. Joseph L. Hallet, who has already been connected with the company for 18 years.

Bergen Point, N. J.—Mr. A. C. Humphreys, the secretary and superintendent of the Bayonne and Greenville gas company, retires to take charge as engineer of the Ptntsch gas lighting company, and his place is filled, on 1st instant, by Mr. C. J. R. Humphreys, formerly his assistant superintendent.

Intended Retirement of Mr. Livesey.

An unusual amount of personal interest attaches to the next meeting of the South Metropolitan Gas Company which was advertised to take place on the 15th of February. On this occasion Mr. George Livesey will retire formally from the double position of Secretary and Engineer to the Company, which he has held for many years with advantage to the undertaking and distinction to himself. We believe that Mr. Livesey's time of service extends to about thirty-three years; and now, although still in the full prime of his life, he finds the multifarious duties of his double office engrossing so much of his time that he is hampered in respect of that department to which his best energies are devoted. Mr. Livesey will not cease to occupy himself and his engineering abilities in the service of the company. The great gas manufacturing establishment which will shortly be built at East Greenwich will afford scope enough even for his remarkably original genius in engineering construction; and, as a director, his knowledge of affairs will still be available in the conduct of the ordinary business of the company. Mr. Livesey's retirement is less an abandonment of active work than a preliminary to work in a more expansive sphere, wherein he will be free from the minor engagements of a strictly official station. Such rest as he may allow himself, however, Mr. Livesey well deserves; and it will be the heartfelt wish of all who know him that he may so husband his strength in his future activities as to ultimately enjoy many years of honorable ease.—*Journal of Gas Lighting.*

[It is with great pleasure that we learn that the directors of the South Metropolitan gas company have selected Mr. Frank Bush to fill the position of Secretary, shortly to be relinquished by Mr. George Livesey. Mr. Bush has been for fifteen years engaged with The Gaslight and Coke Company, during the latter part of this time as Assistant Secretary under Mr. Phillips.

He has therefore passed through a period of experience which peculiarly fits him for the responsible position to which he is now called. Mr. Bush's father was Chief Accountant to the Chartered Company for a period of forty years; and his brother was lately Assistant Superintendent of the Beckton works. The name of the secretar-elect is therefore closely identified with the Metropolitan gas interest. Mr. Bush is still so young as to warrant his expectation, in the ordinary course of things, of a lengthened period of service in the new sphere which now opens before him; and he carries with him not only the business training and knowledge of affairs that he has acquired in the admirable school which he is about to leave, but also the respect and esteem of his old superiors and fellow-officers.]

Electric Light and the House of Commons.

It is stated that it is not the intention of Her Majesty's Office of Works to employ any form of electric lighting in the House of Commons, at least for the present; but should further experiments prove more satisfactory than those tried last year, the light may, it is stated, be permanently adopted after the Easter recess.

Paddington Vestry—Electric Lighting.

At the last meeting of the Paddington Vestry a report was presented by the General Purposes Committee upon the comparative cost of the electric light and gas in a certain main thoroughfare of the parish. The report stated that owing to the large outlay which would have to be incurred in the purchase of plant, etc., the committee were of opinion that the time had not yet arrived for inviting tenders for lighting the parish by means of the electric light, and further that it would neither be advisable nor economical for the Vestry to enter into arrangements of the kind. The committee called attention to the experiments now being made in the city, where three rival systems were at work for twelve months, the several contracts being with the Anglo-American Brush Company, £1,410, or £44 per lamp; the Lontin System, £2,930, or £91 per lamp; and Messrs. Siemens system, £3,720, or £116 per lamp, exclusive of plant, each lighting equal areas.

Of the three methods, the first, which was the lowest in price, was considered the best light and the simplest in its action. The committee had ascertained that the cost of displacing 76 public lamps and four Bray's lamps, between Edgware-road and the eastern end of Westbourne-grove, would, as an instance, be very great. Those lamps at present cost £376 5s. 8d. per annum, including salaries and everything, whilst the cost under the electric system would be £738 13s. The first outlay would be £1,963 8s., or a gross sum for the first year of £2,702 1s. for the sixteen necessary electric lamps. There would have to be duplicate engines, boilers, etc., in case of breakdown, or the streets might be left in darkness.

Mr. J. P. Anderson said this was a very large question and should be very carefully considered, and he would move that it be taken into consideration at the next meeting of the Vestry. The motion was seconded and carried.—London *Metropolitan.*

[Official Report.]

Twelfth Annual Meeting of the New England Association of Gas Engineers.

Held at Young's Hotel, Boston, Feb. 15, 16, and 17, 1882.

The Association was called to order at 11 o'clock, President W. A. Stedman, of Newport, R. I., in the Chair.

Upon the calling of the roll, the following members reported as present:

William Yorke, Portland, Maine.	William D. Cadwell, Nashua, N. H.
A. M. Norton, Nashua, N. H.	Chas. F. Warren, Manchester, N. H.
John Andrew, Chelsea, Mass.	Horace A. Allyn, Cambridge, Mass.
David Brayton, Brockton, Mass.	George D. Bill, Malden, Mass.
David Boynton, Chicopee, Mass.	George D. Cabot, Lawrence, Mass.
Oliver E. Cushing, Lowell, Mass.	H. F. Coggshall, Fitchburg, Mass.
D. W. Crafts, Northampton, Mass.	C. W. Cochrane, Gloucester, Mass.
John Cabot, Lawrence, Mass.	W. B. Durfee, Jr., Fall River, Mass.
W. H. Frost, Plymouth, Mass.	W. W. Greenough, Boston, Mass.
Lyman P. Gerould, Newton, Mass.	Malcolm S. Greenough, Boston, Mass.
Edward Jones, Boston, Mass.	Edward C. Jones, Boston, Mass.
Edwin Keith, Taunton, Mass.	Charles D. Lamson, Boston, Mass.
David Moore, Salem, Mass.	Richard J. Monks, Boston, Mass.
George B. Neal, Boston, Mass.	Thomas J. Pishon, Boston, Mass.
C. F. Prichard, Dedham, Mass.	J. F. Rogers, Boston, Mass.
J. H. Rollins, Worcester, Mass.	Chas. F. Spaulding, Brookline, Mass.
Isaac R. Scott, Waltham, Mass.	J. Q. A. Spear, Boston, Mass.
Chas. S. Spaulding, Br'kline, Mass.	D. D. Tilton, Newburyport, Mass.
J. R. Todd, Natick, Mass.	Robt. B. Taber, New Bedford, Mass.
Gideon Wood, New Bedford, Mass.	L. W. Wells, Marblehead, Mass.
Eugene H. Yorke, Lynn, Mass.	Samuel G. Stiness, Pawtucket, R. I.
Wm. A. Stedman, Newport, R. I.	A. B. Slater, Providence, R. I.
Ogden Gilmor, Norwich, Conn.	John P. Harbison, Hartford, Conn.
C. H. Nettleton, Birmingham, Conn.	F. C. Sherman, New Haven, Conn.
Patrick Coyle, Charlestown, Mass.	John M. Hill, Concord, N. H.
Milton Jewett, Clinton, Mass.	W. K. Stratton, Haverhill, Mass.
Wm. Tarbell, Waltham, Mass.	H. A. Atwood, Plymouth, Mass.

The Secretary read the minutes of the last semi-annual meeting, and also of a special meeting held on the occasion of the death of Charles S. Colbath and George Dwight. The minutes as read were approved.

The Directors reported, with approval, upon the application of Patrick Coyle for membership, and he was thereupon unanimously elected a member of the Association.

President's Address.

President Stedman then read the following address:

Gentlemen of the Association:—We are again met in annual convention, after a year of very marked increase in the business which we represent. The stimulus of good times has affected our interests favorably, and while the pressure of augmenting demand compels many to enlarge and improve their means of production, it is pleasant to know that a good degree of financial success during the year just closed furnishes the means by which the most efficient improvements can be commanded. What are the best, is a question whose answer has doubtless been deferred, in many cases, to the present meeting. Let us hope that our discussions will evolve convincing answers.

What have we been doing in promoting the economies of production? The average price at which gas has been sold has greatly declined in the past ten years, and this fact speaks well for the prudence and enterprise with which the business in general has been managed. The way to greater economies is in some directions open, and we are one after another traveling in that way, as the conditions of our various situations allow us. Other ways are to be pointed out, and the fortunate ones who have made discoveries, of little or great importance, are here, I trust, to announce and explain them. All are here to learn, and I ask of you all your prompt attendance and unremitting attention during the sessions of the Association.

There has been an increased acceptance of the regenerative furnace and an extension of its introduction. With greater familiarity, doubtless some new light on the manner of working it and of overcoming the novel difficulties which were at first met will be given to the meeting. There seems to be marked saving in fuel and labor attendant on its use; and doubtless no subject will be more prolific of discussion.

I am not aware of any noted increase during the year in the volume obtained from a pound of coal. Neither has there been announced any improvement in purification whose merits have received general acceptance. It has been proposed to use the spent animal charcoal from sugar refineries to absorb ammonia, and thus make a valuable fertilizer, without the necessity of the present process of working the ammoniacal liquor. More practical results are needed before we take stock in the improvement.

In the utilization of residuals we have unfortunately made little progress toward the hopeful ideal which has been set before us so eloquently and seductively by the gentleman whose lectures on the subject you have heard at the meetings of the American Association. I believe, however, that the logic of events in the near future will certainly exact more consideration than we have hitherto given to our tar and ammoniacal liquor. A movement is on foot in the West which looks just now as if it might lead to solid results. The proposition is made that gas companies within a district not so large but that all parts may be within easy and cheap communication with a common center, and yet so large that the total of residuals may be in quantities to secure the utmost economy in working, should pool their products and equitably divide the products of conversion. This plan places the control of operations with the parties most directly interested, provides abundance of capital and a sagacious oversight of the business, and gives permanence and stability to the demand for the by-products of the companies connected with the pool. Some such plan may yet be perfected, with a good degree of success attendant upon it. Its adoption may help us on the road to dollar gas.

In the field of distribution there is a recognized gain in the application of gas to heating and to motive power. Manufacturers of gas stoves have made many improvements in adapting them to the varied needs of household comfort and economy; and we need to appreciate and supplement their work by urging the attention of our consumers to the modern appliances whereby gas cooking can so largely diminish the anxieties of the kitchen. The "Cheerful Reflecting Gas Stove," for heating, has met with great favor, in that, more than any other, it is free from unpleasant odors. The gas is burned in small jets, without previous mixture with air, and perfect combustion is obtained. The designs are neat, and with their corrugated reflectors give a faint reminiscence of an open fire. The atmospheric burners of all kinds heretofore used in heating stoves have at times imperfect combustion and consequent bad ordors.

There is need of a good gas engine, which will be economical of fuel, and of first cost reasonable enough to be within the means of ordinary purchasers. A hopeful acquaintance of mine, who is an excellent mechanic and of some note as an inventor, is now and has been for some time past at work endeavoring to produce a machine of the above description. He says he has got it; and we all hope he has.

While the outlook for the year to come is a flattering one, we grieve to go forward to its duties deprived of the companionship of two cherished members of our Association. We miss them sadly to-day, and it is hard to realize that we shall meet them no more. It seems as if presently the door would open and the bright smile and cordial greeting we were wont to look forward to would appear in Charley Colbath's face; or that, in the stately dignity of his ripened age our beloved Dwight would extend his hand. Warm, faithful, generous hearts had they both. One in the flush of his manhood, one with his threescore and ten years all but reached, almost together they are gone down into the dark valley. How poor and trite seems the most glowing eulogy to those whose privilege it has been to know intimately our departed friends. And yet with what glad satisfaction shall we presently listen to the testimony of those who will speak, out of the fulness of affection, their tributes of appreciation and praise.

And now, in closing, I desire to return to the members of this Association my sincere thanks for the honor they have conferred in twice calling me to preside over their meeting, and for the uniform courtesy and deference accorded to the position of President while it has been my fortune to occupy that office.

On motion of Mr. Stiness, the Association tendered to the President a vote of thanks for his very able and characteristic address.

Correspondence.

The Secretary read letters from Mr. Edwin Ludlam, of the People's Gas Light Company of Brooklyn; Gen. A Hickenlooper, President of the American Gas Light Association; Mr. William H. White, of the Equitable Gas Light Company of Baltimore; and a telegram from Mr. A. C. Wood, of Syracuse, N. Y., regretting their inability to attend.

Treasurer's Report.

The following is a summary of the account of the Treasurer, read by Mr. Neal.

Total receipts	$297 00
Total disbursements	238 78
Balance on hand	58 22

The disbursements include $34.38 advanced by the Treasurer last year, so that the real amount by which the receipts for the year exceeded the expenses was $92.60.

Permanent fund—

Deposited in Charlestown Savings Bank	$500 00
" Warren Institution for Savings	500 00
Total	$1000 00

The annual interest on this fund is $45.

REPORTS OF COMMITTEES.

The Secretary—At the semi-annual meeting there was a matter referred to the President and Secretary, and it was

Voted, That the Secretary be requested to procure the signatures of every member of the Association to the Articles of Agreement, with a statement of the date of birth and the time of first connection with any gas company.

Voted, That Mr. Slater and the Secretary be requested to prepare and put the same in due form for the signatures of the members.

Mr. Slater—That Committee report progress and ask to be continued.

A motion to that effect was made and agreed to.

The Secretary—The Executive Committee announce that the name of John W. Averill, of Portland, Maine, has been dropped from the roll at his own request. The Executive Committee have approved the following papers:

"Purification," by S. G. Stiness.

"Tar as Fuel," by F. C. Sherman.

The Committee recommend that the proceedings of the meetings of 1881, and 1882 be printed in the same form as were those of 1880.

Mr. Allyn—Can the Committee give us any idea of the expense?

The Secretary—The proceedings of the meeting of 1880 were printed, and a few were bound in book form for distribution to companies outside of our Association. The expense was something over $120. Of course, the expense for printing the proceedings of two annual meetings, as is proposed by the Committee, will be something more than that. There will not be funds enough in last year's balance to meet the expense. It has been suggested that a charge be made for each book delivered. That would help pay the expense.

Mr. Stiness—In printing the proceedings of our Association we are making history, and the the expense should not weigh very heavily with us at the present time. Having gone so far, I trust that we shall continue to print the proceedings, either every year or every two years. I believe that we can economize in some other matters, if necessary, to enable us to print the proceedings. They will be invaluable to us in the years to come. I move the adoption of the recommendation of the Committee, that the proceedings of the two years be printed.

The Secretary—Our expenses for the past year were comparatively small. For the annual meeting they were $53, and for the semi-annual meeting only $6.35. This includes the payment of considerable printing and postage. I think that for the coming year our expenses will be even less, and that we can well afford to print the proceedings. I think that when this year's dues are paid in there will be money enough for the work.

Mr. Cabot—I second the motion as to the printing, and move as an amendment that the Secretary forward a copy to each member of the Association.

The Secretary—I should do that without any direction. I would like to have someone associated with me in the matter.

The pending motion was modified so as to read as follows:

Resolved, That the President and Secretary be authorized and directed to procure the printing of the proceedings of the Association for the years 1881 and 1882.

The resolution was adopted.

The Secretary—In addition to the approval of the papers to be read, as already stated, the Executive Committee propose the following subjects for discussion, and recommend that they be taken up in the order in which they are named:

Retort Furnaces; Ammoniacal Liquor; Gas for Fuel; Gas Engines; Gas Burners; The Temperature of Gas at Different Stages of Manufacture.

IN MEMORIAM.

Mr. Stiness, of the committee appointed to prepare a memorial of Chas. S. Colbath, deceased, read the following:

The committee appointed to prepare a memorial of our deceased frater, Charles S. Colbath, respectfully submit the following:

Charles S. Colbath was born in Boston, Mass., July 5, 1841, and died at North Attleboro on the eve of December 28, 1881. He entered the employ of the Boston Gas Company when about 20 years of age, and soon after entered the army in one of the nine months regiments. He returned at the end of his term of service suffering with chills and fever, which incapacitated him for work for some months. As soon as able he returned to his position with the Boston Company. He was married July 2, 1867. On November 1, 1868, he entered into the employ of the Jamaica Plain Gas Company as assistant superintendent, and remained with them till called to North Attleboro, August, 1876, and he remained with that Company till his death in December last.

Such is the history of his short life. In the language of one who knew him well, "He was most devoted as husband, son, and brother. In his business relations he was square and straightforword," and, as we all knew him, quiet in his actions, kind and genial in his nature; and in his death we feel that this Association has lost a worthy member, stricken as he was almost without a moment's notice, in the prime of life, and with every prospect of a useful and happy future.

[Signed] A. G. Stiness,
J. H. Rollins,
J. F. Rogers,
Committee.

Mr. Stiness—I move that in addition to this memorial a page of our record be inscribed to his memory, and that a copy of the memorial be transmitted to his family and to the North Attleboro Gas Company.

The motion was agreed to.

The Secretary—At the meeting held in Springfield, on the occasion of the funeral of George Dwight, a committee of five were appointed to take suitable action in the matter—viz., W. W. Greenough, George D. Cabot, S. G. Stiness, W. A. Stedman, and F. C. Sherman.

Mr. W. W. Greenough—I am requested, on behalf of that committee, to offer the following:

Resolved, That the New England Association of Gas Engineers have heard with deep regret of the death of their late respected associate, Hon. George Dwight, of Springfield, one of the founders of this Association, and one of the oldest, most experienced, and most devoted gas engineers in New England. Endowed by nature with a large executive ability, which was enhanced by cultivation and exercise, the attributes of his character, his clear judgment, his courage, his manliness, his good will and his cordiality, enabled him to fulfill his whole duty to his private and public trusts to the satisfaction of his friends and neighbors, and of the community, which appreciated the real value of the man. He left a marked example of a life passed in performing services not of his own seeking, but accomplished at the request of others.

His loss is a personal loss to this Association. He was the friend of every member, always ready to impart to his brothers the benefits of his knowledge and of the fruits of his practical skill. His kindly smile and frank greeting will be missed whenever its meetings occur, and he has left a gap in its numbers which no one now living can fill.

Remarks of Mr. Neal.

Mr. Neal—Allusion has been made in the resolution to the fact that Mr. Dwight was one of the founders of this Association. A reference to the minutes of the Secretary of the first meeting will show the position he then occupied. It was held at the office of W. W. Greenough, Esq., Treasurer of the Boston Gas Light Company, on the 2d of February, 1871. There were present eighteen gentlemen, representing seventeen gas light companies. "Mr. Dwight, of Springfield, was chosen temporary Chairman, and Mr. Neal temporary Secretary of the meeting." I read this to show that Mr. Dwight was at our very first meeting, and that he was our first Chairman.

I have here also the first Articles of Agreement, and they were first signed by Mr. Dwight; then follow the names of Mr. Greenough, Mr. Armington and Mr. Stedman. Mr. Dwight's name is written in his bold, vigorous, hand; there is not a hair line in the signature; it is firm and brave and bold like himself.

I knew Mr. Dwight for about thirty years; and knew him but to love and respect him. He was a man whose word was law. There was no prevarication in any form about him. He always meant just what he said, and said just what he meant. If asked "Will you do thus and so?" or "Do you believe this or that?" his answer was yes or no, without any reservation or qualification. He was a most delightful man in society. I have passed many pleasant hours with him in Springfield, in the social circle and at his place of business. I agree with the spirit of the resolution—that his loss to us is great, and his place one which cannot easily be filled.

Remarks of Mr. Stiness.

Mr. Stiness—Before we proceed to the next business, of receiving the reports of committees, I desire to say a single word in memory of our friend. It is with a sad heart that I realize that the familiar form of George Dwight is no longer with us. Memories of him crowd round me to-day, as they did last night when we gathered at the Tremont House, as has been our custom from year to year on the evening before the annual meeting of the

Association. We missed then, and we do now, the form of that good, noble-hearted man. I am sad to-day, as I was when I stood before his last resting place, shrouded then with the fairest flowers, as it is shrouded to-day with the very purity of heaven. He rests to-day beneath the sod; and we mourn his loss. Soon fair flowers will spring up over his grave, and I would like to add to-day the fragrance of the flowers of memory to that dear name. Whenever you speak the name of George Dwight, it comes out with a fullness that literally means the perfect man. He has passed on; and who is there that would not follow where he has gone. George Dwight has left foot-prints on the sands of time that can never be obliterated.

Remarks of Mr. Cabot.

Mr. Cabot—I did not intend to make any remarks, for it seemed to me that the resolution covered all that we could say in regard to Mr. Dwight. He was a dear friend of mine. That is all that I can say. I hold in my hand the last letter which he is supposed to have written; and as it refers to this Association I will read it. It was sent to me by Col. Armington, of Brooklyn, with a request that I would read it. It is dated six days before his death.

I might say here that it had been the hope of many of us that Mr. Dwight would reconsider the stand he had taken some years ago, and would consent to become the President of our Association.

"SPRINGFIELD, January 25.

"MY DEAR ARMINGTON:—In reply to your very kind letter of the 12th inst., I must say that, after giving it careful consideration, and at the same time desiring to comply with your request, as also to meet the wishes of so many of our dear friends whom you represent, I cannot see my way clear to accept the honor you propose to confer upon me. My reasons for declining are the same in part that decided me to decline the honor years ago, when the Association so kindly gave me their vote to fill the office of President. I find, as life moves on, that it has taken my vim. A man who is entering his seventieth year cannot do his duties as he would at fifty. And, besides my age, within the past six months I have found that parts of my system are giving out. Up to that time I was strong in health, and had no drawback in any way; but at this time I find myself with a *heart*. My friends may say that they knew I had one always. It has been my pride to have them think so. I have found it out myself; and by its palpitations it gives me warning that it has been at work for nearly seventy years; and for the balance of time which my Heavenly Father gives me in this world, I must keep from everything that would cause excitement. I cannot take the office and come before the men I love so well without being filled with emotion; and it would not be advisable to put myself in that position. Now, my dear friend, having given you my reasons why it will not be in my power to do as you wish, please pass me by and take one who is in the full strength of body and mind to fill this important office—a position that any man may be proud to hold. * * * *

"I attempted to write to you ten days ago, but was used up and could not complete it until to-day. I hope to meet you in Boston and have a good time; and I propose to obtain from you all the information about my trip south."

Mr. Dwight was at that time making arrangements to go South with his wife in the present month. I can only say in closing that among the highest qualities I know are justice, truth, and love; and I think if ever a man possessed them all George Dwight did.

Remarks of Mr. Sherman.

Mr. Sherman—It is with a sad heart that I rise to add my tribute with regard to this sad event. My acquaintance with Mr. Dwight extends over a period of 27 years. It may be news to some of you to learn that Mr. Dwight was engaged in building gas works. He built works in Ware, Westfield, Greenfield, Beverly and Norwich. My first lessons in gas making were taken under his instruction in the first works he built. When I left those small works to take charge of larger ones in another State, he went with me and gave me a send-off in the way of advice and suggestions. For the first twelve years of my gas life I saw comparatively little of him; but for the last eleven years I have been one of his neighbors, and have enjoyed a degree of intimacy with him which very few of our members have been privileged to enjoy.

As a manager of gas works he was very successful. The Springfield gas works, under his management from their inception, have been the most successful, financially, of any works in New England—the gas consumers at the same time being well and faithfully served. All who came to his office on business, from the poor washwoman, who came to order coke, to the millionaire, were alike treated courteously and with respect. In carrying on the business he adopted all the improvements which commended themselves to his judgment; without being carried away by every new thing which promised large results, he was not slow to appreciate improvements, and was willing to pay for them. The conservatism which usually comes with advancing years never came to him; he was as ready to appreciate and adopt improvements at threescore and ten years as he was at forty.

His works were kept in excellent condition; while there was nothing spent for a vain show, there was free use of paint and whitewash. His leakage was the smallest of any works that I know of. In purification he excelled—purifying more gas, per bushel of lime, and sending out gas freer from ammonia than any other works that I know of. His results in the retort house were excelled by none and equalled by few. He devoted great attention to his meters; they were all tested once in three years. His mains were carefully examined every year. As illustrating the spirit of enterprise which remained with him to the last, he entered, in the last four years, upon the new enterprise of sending out steam for heating purposes. He was the first man to take up this new business, and of the score or more who have followed him he is the first to show a balance on the right side in this business; he brought to the steam heating business the same good judgment, the same careful watch over details, which made the management of his gas works such a great success. Without putting on any airs, or claiming any superior knowledge of our craft, such was his great success in constructing his own works that his advice was sought far and near by his brethren engaged in the same business; and the humble manager of a works sending out three millions per year, and the engineer of a works sending out its hundreds of millions, were alike received with a cordiality and courtesy that made each feel free to ask any question that suggested itself from an inspection of his works.

He delighted to impart information. He had a pleasant way of listening. An ordinary stoker would leave him with the impression that he had conferred a favor by talking to him. As a manager he was a safe one to follow, and one whom we may all pattern after.

As we leave the manager and come to the man we, who have known him longest and best, have no language to express our appreciation of his worth and our loss in the removal of such a valued friend and member of our Association. He was a generous, open hearted, sympathetic, Christian gentleman. It is impossible to associate anything mean, or jealous, or envious, or censorius with him.

To know him intimately, as I did, was to love, respect and venerate him. I was often in his company, several days at a time. I never heard him utter a word or express a thought that might not have been uttered with propriety in his own parlor. I never heard him mention the name of a member of this Association in a way that would leave a wound if uttered in the presence of the member spoken of. When informed that some member had fallen in the battle of life, under its burdens and many temptations, he held his peace or offered extenuating circumstances in mitigation of his lapse. His chief clerk, who has been in his office, for 18 years, writes me that Mr. Dwight never gave him an unpleasant word in all that time. He carried heavy burdens uncomplainingly, with patience and fortitude. The savings of a lifetime were swept away at a single stroke. He met this loss, and the attendant loss of position, which accompanies misfortune, without a sign of impatience. I never heard him remark unpleasantly on the parties through whose mismanagement he lost his money.

He bore the ills and burdens of life silently, and spread sunshine and joy wherever he went. Little children clung to him instinctively, and those of us in the midst of the battle of life came and laid our burdens at his feet, sure that we should receive sympathy and aid. The life of the average gas manager is no holiday existence; between his stockholders, who are often unreasonable, and his customers, who look upon the business as a legalized fraud, he is kept in a continual fret and worry. Our friend Dwight found it so in his experience, and he had his hours of gloom and despondency. That I was able, through my visits and correspondence, to administer cheer and relief to him will be a source of ever-increasing pleasure to me.

The last time I saw him alive was the day before Christmas, at his works. Such a change had come over his countenance since I had seen him that I was greatly shocked, and could scarcely conceal my emotions of grief at his changed appearance. He said his physician had informed him that a deadly disease lurked in his system, that a mortal arrow was likely to strike him any moment; but he felt no fear. He was cheerful, talked over his plans for enlarging his works the coming season. On his way up-town to his office he called at a market and ordered two turkeys for two poor families for their Christmas dinner.

The news of his sudden illness and death was no surprise to me. Thus there has passed away one of our number whose sun went down while it was yet day.

To a few of the older members of this Association his memory will always be green. To the younger members he presents an example of right living, of fidelity to the trusts committed to his care, of strict and uncompromising honesty in the affairs of everyday life, and of a tender regard for the character and feelings of those with whom he was associated that they will do well to follow.

On motion of Mr. Stiness it was ordered that a page of the record be suit-

ably inscribed to the memory of George Dwight, and that copies of the memorial be transmitted to the family of Mr. Dwight, and to the Springfield Gas Light Company.

AMENDMENT TO THE XII. ARTICLE OF AGREEMENT.

The following amendment to the XII. Article of Agreement, proposed at the last semi-annual meeting of the Association, having been duly notified to the members, was put upon its passage:

"If any member shall neglect to pay his annual assessment for the space of six months after his assessment shall become due, said member shall thereby incur the penalty of an additional $2.00 to such assessment, and if the assessment together with the penalty shall remain unpaid for the space of two years, the delinquent shall cease to be a member of the Association."

On motion of Mr. Nettleton, the Article was so amended as to read as follows:

"If any member shall neglect to pay his annual assessment for the space of six months after such assessment shall become due, said member shall thereby incur the penalty of an addition of $2 00 to such assessment; *provided* that, in all cases before such penalty of two dollars be added, notice in writing be given to each member whose dues are unpaid; and if the assessment together with the penalty shall remain unpaid for the space of two years, the delinquent shall cease to be a member of the Association."

The amendment was then unanimously adopted.

ELECTION OF OFFICERS.

On motion of Mr. Stiness, that a committee of five be appointed by the Chair to present nominations for officers of the Association for the ensuing year. The President appointed the following committee: Messrs. S. G. Stiness, C. F. Spaulding, H. A. Allyn, A. M. Norton, C. D. Lamson.

The committee then retired for consultation and, upon returning to the hall, presented the following report:

Mr. Stiness—As Chairman of the Committee to nominate officers for the ensuing year I am directed to report that it was with regret we were compelled to accept the declination of one who has graced the Chair of this Association for the past two years—President Stedman having informed me previous to this morning, and again upon our departure from this room, that under no circumstances would he accept a re-election. The Committee respectfully report that they recommend, as officers for the ensuing year—

For *President*—A. B. Slater.
First Vice-President—M. S. Greenough.
Second Vice-President—J. P. Harbison.
Directors—John Andrew; F. C. Sherman; J. H. Rollins; O. E. Cushing; H. A. Allyn.
Secy. and Treas.—George B. Neal.

On motion of Mr. Lamson, the report of the Committee was accepted, and the President having appointed Mr. Nettleton to cast the ballot of the Association for the gentlemen reported by the Committee, the ballot was so cast, and they were declared the duly elected officers of the Association for the ensuing year.

The President—I assure you, gentlemen of the Association, that it is a very great pleasure to me to find that Rhode Island is so highly appreciated that for three consecutive elections the presiding officer is taken from that state. I did not decline a re-election to this office at this time because I failed in any way in appreciation of the office; but because I felt that I had had my fair share of the honors and the duties connected with the office, and that it was the proper time for some one to succeed me. I will appoint Mr. Stiness and Mr. Cabot to conduct the President-elect to the Chair.

Mr. Stiness—Mr. President, I have the honor of presenting to you Mr. Alpheus B. Slater, of Providence, R. I., whom your fellow-members have elected to the office of President of the New England Association of Gas Engineers.

President Stedman—Mr. Slater, as President I warmly welcome you to the chair which I am about to vacate. I do so with the greater pleasure because I know that the duties will be fulfilled not only to the entire satisfaction of the members of this Association, but also to the continual credit of that little State which we are alike proud to claim.

President Slater—Mr. President, if I shall be able to fulfill your expectations, I shall be more than content. Gentlemen, were I to consult only my own feelings on this occasion, I should certainly decline the honorable position to which you have so kindly elected me; for, following in the footsteps of such men as Greenough, Cabot, Stiness, and Stedman, I realize how much you have the right to expect of me. I thank you most heartily for the honor you have conferred upon me, and hope, with your indulgence, to be able to perform my duties in a satisfactory manner.

President Slater then took the Chair.

On motion of Mr. Neal, all visiting gas engineers, and all those interested in promoting the gas interests, together with any friends of the members, were invited to take seats with the Association during the meeting.

Mr. Stiness then read the following paper on

PURIFICATION OF GAS.

Mr. President and Gentlemen of the Association:—It is not my intention to-day to present to you a dissertation on the purification of gas, but to give the results of the practical operations of my works, as regards purification, from Dec. 1, 1880, to Feb. 1, 1882, in the use of shell lime in the usual way, shell lime in connection with chip shavings or sawdust, and the use of stone lime in connection with chip shavings.

In the early spring, finding I had not a sufficient quantity of shell lime to place in a purifier which demanded our immediate attention, and being unable to procure a supply in season, and feeling that stone lime would be far more expensive than I desired, I looked for some material which would at least add bulk to the purifiers, if not benefit to the purification. Knowing that all the various forms of material which have been presented to us for purification as a substitute for lime contained as one of their principle elements (if not for efficiency at least for bulk) was what is known as sawdust, shavings, chips, or some material of a granular form, and remembering the old maxim, that "condensation is half purification," and believing that scrubbing is one of the principal elements of condensation, I determined to try the experiment of placing 30 or 40 bushels of what is known with us as spool chips, well soaked with water, on the lower trays of purifiers, four or five inches in thickness; then three layers of lime in the usual manner, with the upper tray of lime five or six inches thick. This gives the box the usual amount of material. I am happy to say that it exceeded my most sanguine expectations, and from that time to the present I have continued the use of chip shavings on the lower tray of purifiers, with the same degree of success.

In the early fall, finding myself unable to procure shell lime at any price, and not being fully educated to the point of believing that, while a few bushels of chips in a purifier were of value, to fill the entire box with shavings (without lime) would also result in an increase of benefits equal to the ratio of increase in bulk, therefore I was compelled to the use of stone lime as the only material available to me which I considered worthy of a trial.

Commencing Nov. 1, I determined to give the matter of purification with stone lime a careful trial, noting its cost as compared with shell lime (delivered on the premises), and the results to be obtained from its use. On the first day of December, 1880, we had on hand 200 bushels of shell lime and between that time and Nov. 1, 1881, we purchased 4,600 bushels, making 4,800 bushels used in that time. There was manufactured during that period 31,953,000 cubic feet of gas. The 4,800 bushels of lime cost $667.50, and purified 6,650 cubic feet per bushel, at a cost for lime of 2.12 cents per thousand.

From Dec. 1, 1880 to May 1, 1881, there was manufactured 18,321,000 cubic feet of gas, and 3,000 bushels of shell lime (without shavings) used in purification; making 6,100 cubic feet per bushel of lime, at a cost of 2.30 cents per thousand.

From May 1, 1881, to Nov. 1, 1881, there was manufactured 13,632,000 cubic feet of gas, and 1,800 bushels of lime, in connection with chip shavings, used in each purifier in the purification; or 7,200 cubic feet of gas purified per bushel of lime used, at an expense of 2 cents per thousand.

From Nov. 1, 1881, to Feb. 1, 1882, there was manufactured 15,919,000 cubic feet, and there was purchased and used during that period 225 barrels of stone lime, costing $291; which gives a result of 70,750 cubic feet purified per barrel, and, at 5 bushels of hydrate of lime per barrel, 14,000 cubic feet per bushel, at an expense of 1.83 cents per thousand.

The amount manufactured from December 1, 1881, to Feb. 1, 1882, was 47,872,000 cubic feet, and the average cost for lime was 2 cents per thousand.

While I am well aware that these are not figures of results marked in their character, and, I doubt not, are equalled, if not exceeded, by many who are present here to-day, yet they give a comparative statement covering a sufficiently extended period of time, and under circumstances almost identical in their character, to warrant an examination and trial by others; and I express the hope that, when carefully tried, it will yield results equal if not superior to my own; and I may be allowed to remark in passing that those who know me best are well aware that in any statement which I present, I hardly ever presume beyond the unit column, leaving to my more energetic friends the whole line of figures with which to chronicle their remarkable results, which, if reported to us as coming from some one with whom we are not acquainted, we might be pardoned the expression, "Are they not the regular descendents of that old Gull who founded the Guild of Munchausen?

The question may be asked, What are the deductions which I draw from my examination of the question of purification of gas by lime? I reply that lime, save under peculiar circumstances, is the best material at present in use. It has withstood the test of time and fulfilled all the requirements

made upon it; and I am also satisfied that by the interposition of a tray of chip-shavings, or some material of a like nature, an increased amount of purification may be obtained from a stated amount of lime. Also, that stone lime can be made a successful competitor of shell lime—in nearly every case—always to be obtained, easily to be made ready, cheaply to be transported, and, I believe, possessing other merits which practical experience will determine.

From the best information which I have been able to obtain the cost of purification by lime, in many works, does not exceed 1¼ cents per thousand, and from that to 3½ or four cents per thousand; and while I would not despise the "day of little things," remembering the old Scotch adage, "mony a mickle maks a muckle," I am of the opinion that undue prominence has been given the subject of purification, in experimenting on various articles as substitutes for lime, for, if the entire cost of purification were stricken from the column of expenses, it would hardly be perceptible (in many cases) in the expense of manufacture; and I am fully persuaded that if the same amount of earnest, intelligent investigation had been devoted to some other department of our industry, it would have been productive of benefits more marked in character, enabling us sooner to arrive at the solution of the decimal problem presented to us one year ago by the President of our Association; and I am happy to know that earnest souls who have led the way to the investigation of other problems have taken hold of the decimal problem, and present for our consideration an arch 10 feet long and 10 feet wide, making 100 square feet, and producing 100,000 cubic feet per arch per day, which, being sold for 1,000 mills per thousand cubic feet, would have at least one merit—that of easy reckoning. May the decimal problem soon be solved.

Discussion.

The President—After learning the results which Mr. Stiness had obtained by adding shavings to his purifiers, we tried the same experiment; but, from some reason, the shavings did not produce the same result as the shavings from Pawtucket. We would like to hear from any gentleman who has had any experience in the matter of purification in any form.

Mr. Lamson—We have very carefully tested stone lime and oyster-shell lime, and we have always found the oyster-shell lime much the cheaper. We have at times used, in purification, tan, mixed with oyster-shell lime, for the purpose of lightening it up, and with very good effect.

Mr. Sherman—At the suggestion of Mr. Stiness I tried shavings in our purifiers, but found that we got no advantage from it. We used them at a loss of at least the labor of handling them. The lime did no more work than it did without the shavings; and we, therefore, used them at a loss.

The President—I suppose it is understood that the "bushels" refered to in the paper of Mr. Stiness are bushels of lime as prepared for the purifiers?

Mr. Stiness—Yes.

The President—About what was the price of the shells which are spoken of as being cheaper than stone lime?

Mr. Lamson—We buy all of our lime. At that time I think we were paying 28 cents per barrel for lime delivered at our works, *i.e.*, oyster-shell lime. That refers to the lime after it is slacked, and not to the shells.

Mr. Cabot—I do not exactly understand whether Mr. Stiness claims any advantage from the use of shavings other than an increased bulk in the purifiers?

Mr. Stiness—Yes; I do claim it; but others may not have the same experience in that regard. I have given you the actual amount of money paid during fourteen months as the actual cost of the material for purification. I do claim that I receive a very great benefit from the layer of sawdust five or six inches deep. The material is coarse chips, more like tan than sawdust. We have a great many spool-factories with us, which manufacture a large quantity of spool chips. They are more granular in form than common sawdust. I take those shavings and soak them in water, take them out dripping, and place them in layers five or six inches deep in the boxes. I must say that I do receive a great benefit from their use. If I take a period of seven months and compare it with a previous period of seven months, when I made the same quantity of gas and used the same coal, the same purifiers, the same condensers, making no change in any particular, and in the one case purify 7,000 feet, and in the other case 6,000 feet—it seems to me that, by the use of the stone lime, I must be receiving some great benefit from something.

If, in the one case, the shell lime, costing a certain sum, will purify a certain amount of gas at a cost of two cents; and, in the other case, stone lime costing a certain sum for material purifies a given amount of gas at a cost of 1.83 cents per 1000—it does seem to me that the benefits to be derived from the use of the stone lime, although small, are nevertheless what may be termed appreciable. With us the oyster shells are almost unobtainable at any price. Here is almost a prohibition against their use. My experience now for a series of months has been that, by passing the gas through these wet chips, or shavings, it more evenly permeates through the purifying material. There is another advantage which we sometimes find that, even with the utmost care taken with the purification, there may be a weak point, or a thin point, in the lime, at which impure gas may pass through; but this thick layer of chip shavings is a preventive, to a limited extent, to any gas finding a weak spot through the lime, causes the gas to spread more thoroughly over the box, and brings the gas into more direct contact with the lime, thereby giving greater efficiency.

The President—If Mr. Stiness will explain the treatment of his gas before it reaches the purification, it might enlighten us further.

Mr. Stiness—I will state that I have but one single apparatus between the hydraulic main and the purifier, and that is what is termed a sinuous condenser. There are 16 double rows of pipe, 23 feet high. It is called a friction scrubber. In the first two columns of that scrubber I use water. In the last pipe of the scrubber I also use water. I think my ammonia is reduced to from six to ten grains. It varies from six to ten. I have never found it above ten, and I have found it as low as four.

Mr. Lamson—Is that before it goes to the purifiers?

Mr. Stiness—Yes, sir,

Mr. Lamson—In your claim for advantage in the use of chip shavings, do you claim simply that it is a saving in lime, in that your purifiers run longer; or is it a saving in lime as regards purification from ammonia or from sulphur?

Mr. Stiness—If I gather the drift of Mr. Lamson's question, it answers both objects. The scrubbing and the wet shavings eliminate, in my opinion, a certain amount of ammonia.

Mr. Lamson—There can be no question about that. If you put the wet shavings at the bottom of the purifiers you take out some of the ammonia in those shavings.

Mr. Stiness—My test is at the outlet of the purifier. I am free to say that, taking the practical results from the money paid, I feel that the chip shavings have been a practical benefit to me.

Mr. Boynton—Do you change the shavings at the same time as the lime?

Mr. Stiness—We change them every time, and burn the chips under the boiler. Chip shavings have been very easily obtained with us. As we take them from the purifier we burn them under the boiler after mixing them with screenings from the ashes of the furnaces. We dump them into the screening pile and burn them. I have no doubt they could be soaked and used over again, but we have never done it.

Mr. Cabot—Of what wood are these chips?

Mr. Stiness—They are birch chips.

Mr. Cabot—Don't you think that the acids of the birch wood have something to do with the increase of purification?

Mr. Stiness—I am not free to say in regard to that; but I might perhaps express the opinion that if there were any benefits to be derived from the acid of the wood, the same benefit could be experienced by adding the acid to the water in which any other kind of wood was soaked.

Mr. Cabot—There may be a little more acid in birch than in other kinds of wood.

Mr. Stiness—I have never made any test of that, and I do not know. Necessity, which we claim is the mother of invention, forced me into the use of chip-shavings, and I have continued its use; and I know that at the end of the year my results will be dollars and cents. I think that is the crucial test to apply to almost anything.

Mr. Lamson—Have you ever carefully examined the bottom of the purifiers underneath these shavings? I should think that to expose the wet wood constantly, and for a long period of time, and let it drain upon the bottom of the purifier, you would get some of the effects of the pyroligneous acid. That effect is obtained in wood-yards, where water is allowed to drain from wood; and there may very likely be some such thing occur in the use to which you put the chips. That acid will cut iron quicker than almost anything else.

Mr. Stiness—In some of those boxes we have allowed the chips to remain for nine weeks without a change, and we have found there but very little of what you might call condensation. Our purifiers are well drained, and perhaps it would all pass off into the center seal and disappear. Nothing of that kind has been experienced by us in the bottoms of the purifiers. Pyroligneous acid, as I understand it, is formed only from the destructive distillation of wood and not from the natural soaking in water. As it is only in the destructive distillation of coal that the ammoniacal liquor is produced, so (although I am not a chemist) I think it is only in the destructive distillation of wood that this acid is produced. We have in our place a chemical works, and the only manner in which they produce acids is as we produce our gas—by destructive distillation. In my early days I knew something about chemistry, but, having got on the down hill of fifty, I have forgotten a great deal.

Mr. Coggshall—I notice that you purified 7,000 by shell lime, and by the stone lime 14,000?

Mr. Stiness—Yes, sir.

Mr. Coggshall—If you take into account your labor, there would of course be quite an offset there.

Mr. Stiness—I intentionally omitted the account of labor. As is well known to most of us, we always have in our works men who are unemployed at various times, and the slaking of the lime is done by them; and it was therefore a hard item to obtain. The men were employed in pumping tar, slaking lime, and in the various little things which are incident to the running of the works. My recollection is that it took two men three hours to slake ten bushels of lime. That would be six hours labor, which, at one shilling per hour, would amount to one dollar. I think I tried it once. The cost of the labor in slaking the lime is therefore but a small item. The labor would be the same in both cases.

Mr. Coggshall—Was it the same coal in both cases?

Mr. Stiness—The same coal exactly.

Mr. Coggshall—For the last two months I have used what is called the "Economy Purifying Material." I have purified 25,000,000, and the original cost, including freight, was $200. I have not got through with it yet. I cannot tell what it will cost per thousand until it is exhausted. I think it will last another year.

Mr. Neal—How much to the bushel does that average?

Mr. Coggshall—I have run as high as 14,000. For this $200 I obtained enough to charge my four purifiers, and also enough for three spare ones. I have just now used up my third—or rather I have just got it in; so that I have three purifiers of fresh material, and I have already purified 25 million feet. It would cost much less than one cent per thousand.

Mr. Stiness—Can you give us the cost of handling the iron? That seems to be one item which those who use the process scarcely ever take into consideration. It seems to me that the cost of constantly turning the oxide of iron, to revivify it, is an important item in the question of purification. When lime is used, and the purifier is once emptied, the expense is ended.

Mr. Coggshall—That cost should properly come in. I turn mine four times. It takes a man about an hour to turn it. The length of time which the purifier will run—that is, the increased quantity purified—more than offsets anything that I have obtained from lime. I have run as high as 12,000; but 10,000 is about as much as I can obtain from a bushel of shell lime.

Mr. Stiness—By the use of stone lime a purifier will run double the time, and therefore you save in the cost of changing the purifier; and that is a material point in the cost of manufacture.

Mr. Neal—If Mr. Stiness had asked me the question how much it costs to handle the iron sponge, I should have said that it costs nothing. That would have been my answer, because it does cost nothing. I do not have to hire a single additional man for that purpose. There is one yard man who has considerable to do about the yard, and I take a man from the retort house when needed. Whether I use stone lime, or convert shells into lime, or use the iron sponge, the labor is the same. There is no additional expense for labor.

Mr. Stiness—That is exactly the case with me. We have the men on hand, and it virtually does not cost anything.

Mr. Neal—I cannot say that I purify 15,000 or 16,000 feet per bushel; the average is from 2,000 to 3,000. At the same time, I would not go back to the shell lime on any consideration. Nothing that I have seen as yet would induce me to do so. The iron sponge is stored in a shed adjoining the purifying house, and the work is all done there. There is no outside work to be done. When the purifiers are cleaned, there is nothing to be carried off, as is the case where lime is used. I give the preference to the iron sponge for purification, although I cannot purify more than 4,000 feet to the bushel.

The President—I suppose there is no doubt in the mind of any of us that the amount of work a bushel of lime will do depends upon the treatment of the gas before it reaches the purifiers. Mr. Stiness says that he has no other apparatus between the hydraulic main and the purifiers than the friction condenser. Is there any other gentleman present who is using that and purifying with lime, either shell or stone, in the ordinary way?

Mr. Neal—I might add that whatever amount of ammonia goes with the gas into the first purifier, it is there taken out, and in the last purifier there is none. I find that if I remove the ammonia before it enters the purifiers I can purify more with the oxide—perhaps 1,000 or 2,000 feet more to the bushel. I have sometimes sent in 100 grains of ammonia, and it has come out in the first purifier; from the third or last purifier, nothing. I think I am now sending in about 100 grains, and there comes out of the last purifier nothing.

Mr. Yorke—What kind of acid do you use? And do you know the amount of ammonia in the condensers before the gas goes into the purifiers?

Mr. Neal—The condensers are all right. I am using a scrubber, and purifying over and over again, trying to get it up to a sufficient strength to sell. Parties who are constructing ammonia works there are anxious for me to work up the ammoniacal liquor, which is stored in a gasholder tank fifty-two feet in diameter. They have purifiers which do a little better than mine.

Mr. Allyn—Do you also remove the sulphur compounds? In my opinion it is more important to remove the sulphur compounds than it is the ammonia. How low do you reduce the sulphur?

Mr. Neal—The State Inspector takes charge of that. He removes the sulphur compounds from a small portion of the gas; and sometimes it is 11 grains and sometimes 23 grains—but the latter only occasionally. If that occurs three times, then a hundred dollar bill has to be passed over to the State of Massachusetts. I think it has occurred only twice as yet. It averages somewhere near 18 grains.

Mr. Yorke—What kind of a condenser do you use?

Mr. Neal—The Rowland tubular condenser.

Mr. Coggshall—I pass over about 5 grains into my purifiers and into my scrubbers.

Mr. Neal—You do not sell the ammoniacal liquor?

Mr. Coggshall—No. The State Inspector found 13 grains of sulphur last year, after running one year with this process; and this year he found 17 grains, but it was just before I closed up the old material.

Mr. Sherman—I would like to ask Mr. Neal what his percentage of carbonic acid is.

Mr. Neal—In the State of Massachusetts the carbonic acid in gas is not considered an impurity. Sulphur, sulphureited hydrogen, and ammonia, are considered to be great impurities. I have asked the Inspector to test for carbonic acid, but he has never done so.

Mr. Sherman—I suppose it is not less than 2 per cent.; and that is a reduction of ten per cent. in the illuminating power of the gas. Every member present can easily figure how much each candle power costs him, and if he divides his candle power by what it costs him, he can see what he is losing by the use of iron, and he can ascertain the diminished candle power which he has by the use of the iron. I think it will bring the expense of the iron on the wrong side.

Mr. Neal—That is the only drawback. I am satisfied that there is carbonic acid gas passing through my purifiers, and I have often thought that I would put a layer of lime on a tray of the purifiers in order to remove the carbonic acid. I am satisfied that it does somewhat affect the candle power of the gas.

Mr. Sherman—If you use enough lime to remove the carbonic acid, there will be no advantage in the use of the iron. In my experience it takes as much lime to remove the carbonic acid as it does to remove the carbonic acid and the sulphur together. There is no saving if you remove the carbonic acid separately.

Mr. Coggshall—After using this I tested for carbonic acid, and found one per cent. We then commenced using a thin layer of lime on the upper sieve, and I have been to an expense of $10 up to the present time. the expense is comparatively nothing. My candle power is about 17; and I use on an average, about two gallons of oil to a ton of coal.

Mr. Lamson—You could not spread the lime on very often at an expense of $10.

Mr. Coggshall—I do not have to charge it very often. I bought twenty barrels of shell lime, and am using it. I have no carbonic acid to speak of.

The President—I think that Mr. John Andrew is using the same style of friction condenser as Mr. Stiness. We would like to hear his experience.

Mr. Andrew—I believe I have used that condenser as long as any gas engineer in the country, and I am very well satisfied with it. My purification runs from 9,000 to 14,000 feet per bushel of lime. My ammonia is very low. I do not think any other condenser has been made which can do the work and give the same satisfaction to gas manufacturers.

The President—Have you any other apparatus besides that condenser?

Mr. Andrew—I have not.

Mr. Sherman—What kind of lime do you use?

Mr. Andrew—Shell lime.

Mr. Sherman—About how much water to the thousand do you use to wash the gas in that condenser?

Mr. Andrew—Probably about three gallons per thousand. I think that by using three gallons I save impurities in my purifiers. The water will take off several of the ingredients which otherwise would go to the purifier. I think it is a great mistake to believe that you are going to get rid of your ammonia to the best advantage by using a gallon of water. There are other impurities that you can get rid of by using an excess of water.

The President—Do you pump over the ammonia water in this scrubber?

Mr. Andrew—I do not now; I have done so; and when I did that I had no ammonia. My tank gave out, and I now use pure water.

Mr. Stiness—Our friend Andrew is just one of the kind of men that I like to hear talk. If he now gets 14,000 cubic feet of gas to the bushel of shell lime, I honestly believe that if he would take what is known as the Eastern lime he would get 28,000. I never get into those figures; I cannot. But if in my case it produces the one it will in his case produce the other. There

has been during the past year, as is known to every gas man here, a "corner" in oyster shells, We cannot get them with us; and I believe it is a very good time to give this question of stone lime a clear and practical test, and then we can shake our fingers at the fellows who want 15 cents per bushel for shells. I know what our friend Andrew did years ago in the matter of purification, but I have never been able to do it. And I repeat, that if I can purify 14,000 feet from a bushel of stone lime, he will purify 28,000.

Mr. Andrew—I do not want to be understood as saying that I purify 14,000 as an average. I think my average is about 9,500. I have reached the point of 14,000 when using the ammoniacal liquor. By using clear water I get from 9,000 to 10,000.

Mr. Neal—I would like to ask Mr. Benson about his purification. He uses the same kind of a scrubber I do.

Mr. Benson—I cannot show any such figures in purification as our friend Mr. Andrew, nor even as high as some other figures that have been mentioned here to-day, for the reason that our condensers are inadequate to the amount of gas that we have been making during the past four months. This subject possesses unusual interest to me, from the fact that we are just now cramped in the matter of condensation, and are therefore compelled to allow a large amount of tar to go into the purifiers which should not be there. Every time we change the purifier I find a large amount of tar in the lower layers of lime. We are now changing our purifiers more on account of the tar in them than on account of the sulphur that we take out. My average last year was 4,900 feet per bushel. With the kind of coal we are using, my experience is that when we make less gas and have not so much tar in the purifiers, we average over 5,000 feet to the bushel of shell lime. I think we misunderstand or misuse this word condensation. We are in the habit of considering that the matter of cooling the gas, or reducing it from a higher to a lower temperature, is condensation. I think that is a wrong use of the word. My idea of condensing gas is that it is the removal of impurities. If impurities are removed by cooling the gas, I do not know it. You can cool gas by passing it through a condenser surrounded by water, provided the water is of a lower temperature. If it is so arranged that the gas passes from a warmer to a cooler strata of water, you will cool your gas, but I doubt if you will remove much tar from it. I think the term condensation should be restricted to that which has the effect of removing some of the impurities, as the frictional scrubber removes some of the tar and a portion of the ammonia. I think the friction scrubber is a large movement toward good purification.

The President—I think that Col. Stedman is using something of the same kind. The friction condenser that Mr. Stiness uses seems to have something to do with the amount of gas which he purifies per bushel of lime.

Mr. Stedman—We use a friction condenser of the same style as that of Mr. Stiness, and I think that it is very efficient indeed in taking out the tarry particles which are otherwise left behind by the cooling of the gas. Anyone who is familiar with the form of the condenser will know that the gas in passing through it is constantly turned over and over, and has to frequently come in contact with the metallic surface of the condenser; and I suppose that the tarry particles will, in great measure, adhere to that metallic surface. We are using that condenser in connection with washing, and our average purification is about 7,000 feet per bushel.

The President—Do you use any other apparatus for condensing or washing?

Mr. Stedman—We use a "Standard Scrubber" for washing the gas after it leaves the condenser. We use no water in the condenser. It is simply a dry friction scrubber. After leaving the condenser the gas goes immediately into the "Standard Scrubber," which has been explained to you heretofore, and there the ammonia is practically all removed; and then the gas goes to the purifier. I confess that I am somewhat disappointed in my expectation of a decided increase in the amount of gas purified in consequence of washing it in the scrubber.

The President—Do you use shell lime in purifying?

Mr. Stedman—Yes; we use shell lime. We have not made any very great amount of increase, but there seems to be a uniform amount of gas passing through the purifier.

The President—How many layers of lime do you put in?

Mr. Stedman—We put in three layers of lime. The purifiers are 10×16. That makes about six inces on the two lower layers and not quite so much on the other.

Mr. Stiness—Is the scrubber and washer which you have spoken of a combination of scrubber and washer? Or is it simply a process of washing, the other part of the apparatus doing the scrubbing and condensing?

Mr. Stedman—The tar is almost entirely removed by the condenser. We design also in it to reduce the gas, as nearly as possible, to a uniform temperature—say of 60°. With our condenser that is next to impossible when the temperature of the air is about 60°. In the winter time we can, without much difficulty, keep it at an average temperature of 60°. When the gas leaves the condenser at 50°, the use of a gallon of water in the scrubber will remove all of the ammonia, and leave us an ammoniacal liquor of 10-ounce strength. I have repeatedly analyzed gas washed in this manner, and the strong ammoniacal liquor has shown that quite a percentage of sulphuretted hydrogen has been removed; and about 50 per cent. of carbonic acid is also removed in passing through the strong ammoniacal liquor. Yet we have not seen such high percentages in the number of feet purified by our purifiers since we adopted the "Standard Scrubber."

The President—In what condition do you put the lime into the purifiers?

Mr. Stedman—It is very wet—just about as wet as we can handle it.

Mr. Stiness—Does it give you any back pressure?

Mr. Stedman—No; because our purifiers are large for the amount of gas that we send through. There is something less than a thousand feet of gas per square foot of surface.

Mr. Stiness—Will not that have something to do with the amount of gas that you purify—because of your passing it through at such a slow rate?

Mr. Stedman—That is an advantage; but it has sometimes seemed to me that a little pressure on the purifiers is also an advantage in the amount of gas that would be purified.

Mr. Spaulding—What amount of lime do you use?

Mr. Stedman—I have 200 bushels of lime in three tiers.

[To be continued.]

The "Otto" vs. "Linford" Gas Engine Case.

It will doubtless be fresh in the minds of many of our readers that this action, instituted by Messrs. Crossley Bros., Manchester, some twelve months ago, to restrain Messrs. Linford, of Leicester, from manufacturing a gas engine possessing in its construction certain characteristics, being essentially an infringement of their well-known "Otto" gas engine, was heard some time ago, before Vice-Chancellor Bacon, when the case presented some singular features, and when it was decided in defendants' favor. Owing, however, to the evidence given, and the plea set forward by defendants, on the first hearing, Messrs. Crossley appealed against the Vice-Chancellor's decision, and last week the case came up for hearing in the Supreme Court of Appeal, before the Master of the Rolls, when the former decision was entirely reversed.

Engineering, of February 3d, gives the following:

Few recent cases in the law courts have attracted more attention in the mechanical world, or been of more importance to engineers, both from a commercial and a legal point of view, than the case of Otto *v.* Linford, which was decided on Friday last by the Court of Appeal sitting at Lincoln's Inn. For a patent case the constitution of the court was all that could have been desired, consisting as it did of the Master of the Rolls and Lords Justices Brett and Holker. The plaintiff was represented by an imposing team of counsel, viz., Messrs. Aston, Q.C., Hemming, Q.C., Davey, Q.C., and W. N. Lawson, while the defendant's counsel were Messrs. F. C. J. Millar, Q. C., Brett, and De Castro. Mr. Kay, Q.C., originally led for the defendant at the trial, which took place in March last year before Vice-Chancellor Bacon (and of which an account will be found in *Engineering*, vol. XXXI., page 338), but he was removed to the bench just before the conclusion of the trial there. The result of the present appeal has been completely to overthrow the Vice-Chancellor's decision, and to reinstate the Otto patent.

It will be remembered that the action was brought against Mr. Linford for an alleged infringement of Otto's patent (Abel, No. 2081 of 1876). The subject-matter of this patent is so well known that we need refer to it but slightly, its chief feature being the use of a combustible mixture of gas and air very much diluted either with air or with residual products of combustion of the previous stroke. The effect of this is that the heat developed by the combustion of the charge of gas is distributed over a much larger mass of matter, so that the resulting temperature and pressure are very much more moderate than when enough air only was used to effect the combustion of the gas. The desired charge is obtained by introducing into the cylinder first a charge of air or air mixed with the products of combustion of previous stroke, and then a comparatively small charge of concentrated combustible mixture. Thus near the admission port, where the charge is fired, the mixture is of proportions which give an explosive mixture, and are readily ignited, whilst on going further from the point of ignition the mixture becomes more and more diluted, being, in fact, throughout the greater part of the cylinder, of such a nature that the application of a light in the ordinary manner would fail to ignite it. Ignition, however, is a mere question of temperature, and though an ordinary flame in the open would be insufficient to raise to the temperature of ignition any of the isolated gas molecules in such a dilute mixture, except those in the immediate neighborhood of the flame, yet when this diluted charge is in a state of compression, as in the Otto engine, the heat developed by the ignition of the concentrated

combustible mixture round the admission port is sufficient to raise the whole of the gas molecules to the proper temperature, and to secure the complete though, it is alleged, gradual combustion of the whole charge.

Linford's gas engine, which by this time has become well known, though its further development will now be postponed, whilst possessing some useful features from a mechanical point of view, particularly in its freedom from vertical oscillation, yet involves in its entirety the principle of the Otto engine. As to this there was practically no contest, as the plaintiff's witnesses were not cross-examined on the point, and this alone would be sufficient to conclude it. The Linford engine makes one explosion only to every three revolutions, an inert charge of air being introduced in the next outstroke after the working stroke, as what is called a "scavenger charge," and being partially expelled upon the next instroke. Enough air remains, however, in the space behind the piston to effect the same result which Otto attains, viz., the dilution of the charge which is then drawn in.

Mr. Millar in default of evidence as to non-infringement either from his own witnesses or from cross-examination of the plaintiff's, put in certain indicator diagrams which he wished to present to the Court as written documents speaking for themselves upon the point In these diagrams, the history of which was not inquired into, the indicator line at the commencement of the stroke certainly ran up pretty suddenly to a point and came down with a series of sinuosities due to the vibration of the spring, and from this Mr. Millar was anxious to argue that in the defendant's engine the combustion was of an explosive character and did not involve the features of the plaintiff's engine. The Court, however, refused to construe the diagrams without the aid of evidence; but on defendant's counsel insisting that the story they told was obviously in favor of the explosive theory, the judges distinctly intimated their opinion that it was just the other way. Hence upon the question of infringement there was no real contest, and the only question to be tried was the validity of Otto's patent.

The *piece de resistance* of the defendant was Johnson's Specification 335 of 1860, a communication from Lenoir, and it was contended that Otto's invention was substantially anticipated by the publication of that specification, although there was no evidence to show that a single Lenoir engine had ever been made or worked according to it. In fact, a few months later Lenoir took out another patent, in which the peculiar features of the first patent, which were said to be an anticipation of the plaintiff's invention, were wanting—in itself cogent evidence, in default of direct evidence, that the first invention, so far as it might have been upon the lines of Otto, had been abandoned. The alleged anticipation was founded on a part of Johnson's specification, which said that the operation of the Lenoir slide would be to admit first air and then a mixture of air and gas, words which, as Sir F. Bremwell said in his evidence, taken alone would be applicable to describe the "pith and marrow" of the plaintiff's invention. The specification goes on to say that upon ignition "the gas explodes and heats the air and its combinations, which expand considerably," and further says that, "The object of introducing a supply of air into the cylinder before the gas is allowed to enter is to neutralize the effect of the carbonic acid gas formed by the combustion of the first portion of the inflammable gas, as the carbonic acid gas without being thus neutralized might prevent the ignition of the remainder of the inflammable gas." And the specification tells us, in conclusion, that "the air may be introduced alone into that part of the cylinder where the pressure is to be produced, and the gas introduced alone near the igniter."

It was maintained that this specification, from the ignorance of certain elementary principles which it displayed, could not be regarded as an anticipation of Otto's invention. But a more serious objection remained behind. Supposing that it could be shown that an engine had been actually made according to that specification, which produced the result of admitting first a body of air and then a combustible mixture, the obtaining of Otto's result would have been only a matter of adjustment; and, though the engine was never designed to give this result, yet if, as a matter of fact, it had done so, this would have clearly been an anticipation of Otto's invention. Obviously, Otto, though the first to appreciate the true principles of its action, and to show how, by proper proportions of mixtures, the best result could be obtained, could not have been permitted by a subsequent patent to exclude the public from making the very machine which they would have the right to make on the expiration of Lenoir's patent, even though the public had not known how to use that machine properly. As we have said, the defendant was unable to show that such an engine had ever been made. But even so, supposing that an engine made according to Lenoir's patent would have produced, though unknown to the inventor, the desired result, how could Otto, on his discovery of the true principles of success, prevent the public from making that very engine which had been invented by Lenoir, and described in his specification, and which, with a little adjustment, would work in the requisite manner? This is a point of patent law which seemed distinctly arguable, and on which there was no direct precedent, but which has now been resolved by the Court of Appeal.

We may premise, first of all, that the plaintiffs contended, and this contention was supported by their evidence, that an engine made according to Lenoir's specification would not have produced the required result, and indeed would not have worked at all. It was said with truth that Lenoir's gas slide would admit first air, then gas and air, and then again air, and it was argued that the result of this would be to isolate the combustible charge between two layers of air, so that the rear end of the cylinder, where the igniter was situated, would have been charged with air only, and thus the ignition could not have been communicated at all to the combustible mixture and the engine could not have worked. But it seems to have been overlooked that between the slide and the cylinder there existed a chamber of some considerable capacity. If the capacity of this intermediate chamber were made equal to the volume of air admitted by the slide on either side of the combustible mixture, an adjustment which would have occurred to the "intelligent workman," it would follow that the volume of air admitted last would just be sufficient to expel the combustible contents of this chamber. The effect of this would be that the double volume of air would be admitted next the piston, whilst the combustible charge would reach to the end of the cylinder, and the ignition would take place and the engine would work, if it were regulated so as to admit a sufficient volume of air on the principles which Otto has elucidated.

Fortunately, however, the supposed impracticability of the Lenoir engine did not form the ground of the decision of the Court. In reference to this point and also to another point taken, viz., that Otto did not sufficiently elucidate in his specification the proper proportions which were requisite to produce the results, the Master of the Rolls said that from the materials in Otto's specification, a workman would, the idea being given him, introduce a little more and a little more air until he obtained the result which Otto pointed out; whilst from Johnson's specification, the idea in question not being given him, the workman would simply introduce sufficient air and gas to produce the explosion, and would be led no further.

Lords Justices Brett and Holker decided the point on slightly different grounds, and laid down the following principle, which will form an important precedent. Lord Justice Brett says: "It is not sufficient to show that, if a machine had been made in accordance with a previous specification, the user of that machine would be an infringment of the plaintiff's patent. If it requires that a machine should be made for the anticipation to be seen, a subsequent inventor is not obliged to make one to discover the anticipation. He is entitled to find that anticipation in the writing if no machine has been made. And even if the defendant shows that the plaintiff's effect would have taken place in the machine, yet he cannot succeed unless he can show this effect from the specification. Even if the plaintiff's result would have been the result of a machine made according to Johnson's specification, yet since Johnson does not describe the result, that is no anticipation." And for authority the learned judge referred to Hill vs. Evans (31 L. J., Ch. 457.), and Betts vs. Neilson (L. R. 5, H. L. 1).

Upon the same point Lord Justice Holker said: "The question is whether Johnson's specification describes in an intelligible way the invention of the plaintiff. There is a great difference between an anticipation by a machine previously made and one by writing merely. A machine made for one purpose, but which would answer another, might be an anticipation. It certainly would be if so used that the public could know the result. But the case is different when the anticipation is a specification merely. In Hills vs. Evans it was settled that the specification must give you the same information as the inventor's specification. But in this case Johnson obviously never intended to retard the explosion by introducing air."

The single general statement which the master of the Rolls made on this point was somewhat at variance with the principle as laid down above by the other judges. He said: "If, however, it could have been shown that a machine made according to Johnson's specification would have worked according to the plaintiff's principle, that would have been an infringment." We take it, however, that the opinion clearly expressed as above by the other judges must be taken to prevail as the sounder view. According to it the previous machines used differently would not be an anticipation; and it follows that the subsequent inventor whould not be able to prevent the manufacture of the previous machine, but he would be able to prevent its use according to his invention. The point is of much interest to inventors generally, and may now be considered as settled law, unless this last decision is upset by the House of Lords.

The infringement charged related to the first two claims only of Otto's patent, which run as follows:

First, "Admitting to the cylinder a mixture of combustible gas or vapor with air separate from a charge of air or incombustible gas, so that the development of heat and the expansion or increase of pressure produced by the combustion are rendered gradual, substantially as and for the purposes herein set forth."

Second, "Compressing by one instroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder by its previous

outstroke, so that the compressed charge when ignited propels the piston during the next outstroke, and the products of combustion are expelled by the next instroke of the piston, substantially as herein described."

As to the second of these claims, it disappeared from the discussion in the Court of Appeals at an early stage in a very curious manner. At the trial before the Vice-Chancellor, the defendant maintained that the second claim had been anticipated by Barnett's Specification, No. 7615, of 1838, and Boulton's, No. 738, of 1866. In opening the point to the Court of Appeal Mr. Ashton said: "I venture to submit to your lordships that the second claim refers to a compression of a compound charge consisting of combustible mixture in the presence of a notable or adequate volume of inert fluid." And upon this the Master of the Rolls observed: "That is to say you claim two things. You first of all claim the mode of making the mixture so as to produce gradual expansion, and, secondly, you also claim a mode of compressing that." The Master of the Rolls thereupon intimated that if the first claim were good for getting a certain charge, the second claim for doing something to that charge must be good, and that therefore the first claim only need be considered.

All parties acquiesced, and the anticipation on the second claim was discussed no further. No one can doubt that if it had been discussed the result would have been the same as with the first claim. But to us it appears clear that Otto's second claim is far wider than, from the limited interpretation which Mr. Ashton gave to it as above, would appear. The specification has been very carefully drawn, and the expressions therein are not used in a slovenly manner. The expression "combustible gas," or "combustible fluid," is used in the first claim and throughout the specifications as distinct from "combustible mixture," to mean the gas pure and simple. Hence the second claim is for "compressing by one instroke of the piston a charge of combustible and incombustible fluid," etc.,—that is to say, for compressing *any combustible mixture*, and not necessarily the particular form of charge claimed in the first claim. Indeed, the object of the claim seems to have been to claim the compression of any charge by means of an engine similar to the plaintiff's, and in a similar manner. We mention this point because among inventors who have turned their attention to the gas engine there exists a general impression that Otto's patent covers "compression in the cylinder." How far it does so our readers must judge for themselves from the above materials.

We have still to mention the minor points on which the defendant sought unsuccessfully to upset the plaintiff's patent. It was said that the first claim was a claim for an idea; but clearly the words "as set forth" relegate the claim to the machine described in the specification working in the described manner. It is nevertheless true that though the claim is not in form one for an idea or principle, yet that practically it is so in substance. This arises from the law that where a principle is new the patent will be held to cover not only the particular mode shown of carrying it out, but also every mode which is substantially the same. And in the case of a new idea, the words "substantially the same" have a much wider scope than they would otherwise have. "If yours is a new purpose," said the Master of the Rolls, "obtained for the first time, he cannot be allowed to do the same thing even by *similar* means."

Another point taken was that the drawings in the plaintiff's specification were incorrect and insufficient to enable the "intelligent workman" to make the machine. The drawing of the gas slide was such that it would require some alteration to make it operate in the manner described in the specification; but the plaintiff's evidence went to show that the alteration required was such as a workman conversant with the subject and from the letterpress of the specification would be able to make. The matter was thoroughly sifted by the Court, and, obviously, according to its present temper, a specification in which an error existed which would really have a misleading effect, would not be worth much. The objection was, however, overruled, the Master of the Rolls remarking that "it was not for the Court to find out how not to do it," that no practical man had been brought forward to say he had tried to make the machine from the specification and failed, and that in practice no difficulty would arise.

Other points of little weight were raised for the defence. As, for instance, the impracticability of the Otto engine, it being contended, among other things, that the effect of the ignition would be to blow out the igniting flame, and that no ignition would be communicated to the contents of the cylinder. The defence, however, broke down on all points; so much so that the Court did not call upon the plafntiff's council to reply to it.

Palmam qui meruit ferat, and since there can be no doubt that to Otto belongs the credit of having made the gas engine what it is, we congratulate him and the Messrs. Crossley, his sole licensees in England, on the result of this action. This result must, however, have the effect of retarding the progress of the gas engine, whilst the monopoly continues, unless the owners of the patent consent to grant licenses; for, as we have said, no merely mechanical improvements will entitle the inventor to use the principle of dilution as invented by Otto. If licenses be granted under suitable conditions to those who are working at engines which involve the Otto principle, no one will be entitled to complain; but if, as we understand, it is not their intention to do so, then we fear the patentees will be materially aiding the arguments of those who contend that a compulsory granting of licenses should form an essential feature in a reformed patent law.

[From the London "Journal of Gas Lighting."]

Gas Engines versus Steam Engines as Sources of Motive Power

By H. Leicester Greville, F.I.C., F.C.S., Etc.

In the present article it is not my intention to enter into constructive details of machinery, but rather to place briefly before the readers of the *Journal* some of the leading theoretical considerations involved in the use of gas engines, as compared with steam engines, as sources of motive power. * * * * * *

Taking circumstances as they now exist, we have to consider the theoretical aspects of gas and of steam engines, and I hope to show that the former possesses many advantages over the latter, although workable gas engines are of recent invention, while steam engines have received years of careful study. In considering the comparison between the two classes of machines, we have, omitting minor details, three main considerations, which may be enumerated as follows:

1. Initial cost.
2. Cost of labor and repairs.
3. Cost and proportion of fuel used to power developed.

It is the last of these details which will receive special attention in the present article, as the two remaining considerations are more within the scope of the practical engineer.

Taking the steam engine first we find motive power developed from the combustion of solid fuel in a boiler furnace, which produces a vaporization of water in the boiler and an expansion of the produced steam. Before an efficient power can be developed, so much water must be evaporated, consuming a large amount of heat-energy, and a further quantity of heat is expended in the expansion of the steam, so as to develop a suitable pressure. From the beginning to the end of this process heat is continually being lost; that is, heat is being used in other ways than in the production of motive power. * * * * * *

The total loss of heat from all these sources is so great that Sir William Armstrong has made the following statement:

"Taking a good condensing engine as an example, we may roughly state that, dividing the whole heat energy into ten equal parts, two escape by the chimney, one is lost by radiation and friction, six remain unused when the steam is discharged, and one only is realized in useful work." He subsequently added: "It may fairly be admitted that the greater part of the aggregate loss is inevitable, but are we to suppose that the resources of science, ingenuity, and skill have been exhausted in the attainment of so miserable a result? Nothing but radical changes can be expected to produce any great mitigation of the present monstrous waste."

These remarks were made about a condensing engine of good type and large size. What, therefore, are we to suppose is the waste of heat-energy in the ordinary class of small engines of the non-condensing type, which form by far the larger portion of those commonly in use? No doubt the proportion of efficient work bears an extremely small ratio to the theoretical energy of the fuel consumed. The difference between the fuel consumption of different classes of steam engines is so great that while a large compound marine engine of the best type consumes two pounds of fuel per indicated horse power per hour, the consumption for an ordinary portable engine of the best description, working under the most favorable conditions and with the most careful supervision, is four pounds for the same amount of work, and for ordinary engines in practical daily work from six to seven pounds of fuel are required.

Turning to gas engines, we have altogether a different type of machine for the heat-energy obtained from the combustion of the fuel is developed and utilized inside the working cylinder, and there is neither loss from the employment of a boiler furnace with its attendant chimney, nor from the vaporization of liquid water, while the loss from radiation is minimized, being entirely confined to the cylinder. The direct source of power is the large volume of combustion products formed at the high temperature of ignition from a comparatively small initial volume of gas and air. The degree of this augmentation depends upon the constitution of the gas and upon the amount of air mixed with it before combustion. The composition of ordinary coal gas of good quality may be taken as follows:

Contents of 100 *Liters of Coal Gas (by Volume).*

Hydrogen	51.81,	weighing	4.642	grams.
Marsh gas (CH_4)	35.25	"	25.627	"
Olefiant gas	3.53	"	3.428	"
Carbonic oxide (CO)	8.95	"	11.277	"
Nitrogen and oxygen	0.46	"	0.591	"
	100.00,	weighing	45.155	grams.

Now the products of the perfect combustion of these substances are carbonic acid and water according to the following equation:

$$H_2 + O = H_2O.$$
$$CH_4 + 4O = CO_2 + 2H_2O$$
$$C_2H_4 + 6O = 2CO_2 + 2H_2O.$$

Not to enter minutely into a long series of calculations, the 100 liters of gas would require for their theoretically perfect combustion 524.3 liters of air, making a total bulk of 624.3 liters, and the theoretical volume of the combustion products calculated as gas at the standard temperature and pressure (0°C. and 760 mm.) would amount to 592.4 liters. But as the temperature of ignition, technically known as the calorific intensity, is 2554°C., the 592.4 liters would at this temperature be augmented to 6134 liters, and as the original volume of gas and air amounted to 624.3 liters, the increase in volume at the moment of explosion is $6134 \div 624.3 = 9.7$ times. If we take the normal atmospheric pressure as 14.6 pounds per square inch, the absolute pressure per square inch at the time of explosion would be $14.6 \times 9.7 = 142$ pounds. The effective pressure would, of course, be one atmosphere less, or 127.4 pounds per square inch, as the explosion takes place against the ordinary atmospheric pressure. We see, therefore, that if a volume of gas is mixed with the theoretical amount of air necessary for its perfect combustion, and ignited in a vessel which exactly holds the mixture, and the sides of which are perfectly rigid, the absolute pressure exerted is very great. A single cubic foot of gas treated in this way would exert a total pressure on the whole of the inner surface of the containing vessel of no less than 246 tons. * * * * *

In some experiments quoted by Professor Ayrton, the consumption of gas in a 30-horse power (indicated) engine was 18 cubic feet per horse power per hour. Now, as this volume of coal gas weighs about half a pound, it will be seen that the amount of fuel used per horse power in comparison with that used by a steam engine is small; but as the price of gaseous fuel in the form of coal gas is high in comparison with the price of solid fuel in the form of coal or coke, so the expenditure for fuel per horse power is higher for the gas engine than for the steam engine. A trial run of 300 working days of nine hours each with 30-horse power machines cost £218 14s. for the gas and £176 10s. for the coal and water. There are, however, other details of cost (such as labor, depreciation, etc.) which are considerably less for the gas engine than for the steam engine, so that in the end the gas engine was the less expensive of the two; the total cost, including interest on capital expenditure and all details, amounting to £286 15s. for the steam and £275 14s. for the gas. This last expense includes an estimate of 1s. per diem—£15 in the aggregate—for labor in superintendence of engine, whereas the attention needed is so slight as to necessitate in many cases no extra expenditure for labor.

Finally, it has, I hope, been amply demonstrated that the best type of gas engine is a far more perfect machine than the steam engine; that is to say, it is a machine which develops a far larger proportion of heat-energy into motive power. The steam engine, in fact, possesses defects incidental to its peculiarities of working and construction, many of which are ineradicable, however its details may be modified; and which prevent it converting so much heat-energy into motive power as is possible with a gas engine. With the full recognition of this fact, with the simplification and improvement in the construction and working of gas engines which is sure to come in process of time, and with a probable decrease in the price of gas, the day may not be far distant when the gas engine will largely replace the steam engine as a source of motive power. Not the least among the many advantages which would accrue from such a change would be the saving of the loss of human life which at present results from steam boiler explosions.

The New Superintendent of the Springfield (Mass.) Gas Light Company.

The Springfield (Mass.) *Daily Union*, of February 20th, gives the following particulars concerning the election of Mr. Joseph L. Hallett to the vacancy occasioned by the death of Mr. George Dwight:

The directors of the Springfield gas light company met at four o'clock, Monday, February 20th, and elected Joseph L. Hallett to succeed the late George Dwight as superintendent of the company, a choice that will be very satisfactory to the local public. There have been several applications from out-of-town gas engineers for the vacant superintendency, since Mr. Dwight's death, as the position is one that is much sought after from the high standing of the company, and from the general desirability of this city as a place of residence.

Mr. Hallett has been in the gas office for about 18 years, and his promotion is very fitting and well-deserved. He has lately had the principal charge of the steam heating department of the company's business and he has had the best preparation possible by his long association with Mr. Dwight to take up the latter's responsible work. Mr. Hallett is a native of Hyannis, but nearly all his life has been passed in this city. Before the war he was in the Boston and Albany freight office, and he had a very honorable war record of three years, enlisting as a private soldier and receiving several promotions for meritorious conduct and serving as a signal staff officer under most of the generals in the department of the South. In selecting Mr. Hallett as their superintendent the directors of the gas company have given the best possible appreciation of his long and faithful service in other capacities, and we wish him success in his new and enlarged sphere of duty.

Killed by Electricity.

A singular and fatal accident occurred at Carnegie & Co.'s Union Iron Mills, on Thirty-third street, Pittsburg, Pa., Tuesday, Feb. 21st, at about half-past one o'clock in the morning. In the mill there is an electric machine of sufficient power to run the sixteen lights necessary to illuminate the premises. Some trouble has been experienced in the past with boys working in the mill who persisted in making dangerous experiments with the generating machine. In order to stop this practice a fence about four feet high had been built completely around the engine and a special watchman employed to keep the boys away from it. At the time mentioned Henry Balzer, a workman employed in the plate mill, took a lantern in his hand and went over to a clock hanging near the electric machine to see what time it was. After ascertaining the hour he walked to the machine and stood leaning upon the fence around it. The facts just at this point could not be clearly learned, but from the statements made by persons connected with the mill, it appears that Robert Lyon, the engineer, in connection with some experiments he had been making, had stretched a wire from the machine to one of the other wires and along the top of the fence. While Balzer was leaning upon this fence he suddenly turned around, smiled, and gesticulating "Oh," dropped into the arms of Lyon, who was directly behind him, expiring immediately.

It is supposed that while leaning upon the fence he had touched the wire with his lamp and empty hand, thus forming a circuit, the current passing completely through his body and into the ground. A livid mark around the throat and a long furrow running from the thigh of the left limb to the ankle showed the course taken by the electricity. Otherwise Balzer looked as if he had fallen into a deep sleep.—New York *Herald*.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Naphthaline.

To the Editor AMERICAN GAS LIGHT JOURNAL:

Having been called here to prescribe for a disordered system of distribution, on examination we found the cause to be naphthaline affecting nearly every part of the city embracing about forty miles of mains.

Our first prescription was superheated steam, with naphtha, injected into the mains. This relieved some local difficulties, but did not reach far enough. Finding the trouble so general we advised fitting three retorts in a bench of six to make gas from crude petroleum, which was accordingly done. Two days from the time we commenced to make the oil gas the good effects were felt, and in three days we had good pressure in every part of the city

Bearing on this subject—I have just been making an experiment that may be of interest to some of your readers. Before me is a four-feet burner which has been burning 16 hours; the gas to supply this burner has been passing through a three-quarter inch glass tube, one foot six inches long, which is partially filled with naphthaline, to represent, as nearly as possible, a piece of main-pipe. The naphthaline is entirely gone, "and like the baseless fragment of a vision, left not a wreck behind." The illuminating power of the gas was about 20 candles.

We have repeated the experiment with 18 candle gas, enriched with cannel, with equally good results; but having used a hot scrubber six years ago, we most cordially endorse all Mr. Stedman said at the Boston meeting in reference to its value as a preventive against naphthaline deposits in the mains, and as a means of retaining it as an enricher in the gas.

I see that some of your correspondents are in trouble about stopped stand pipes. High heats invariably bring stopped stand pipes. I have tried all sorts of remedies; but the simplest is a properly made scraper pushed three or four feet up the stand pipe, at every charge, and let this scraper be as near the size of the pipe as possible. If your stand pipes are six inches, your scraper should be 5 or 5¼ inches; insist on this being used every charge from the time the bench is started, with the pipes clean, and you will have very little trouble with stopped pipes. I find that the pipe cleaners in use are generally from two to three inches diameter, and are not properly made for scraping. W.

THE AMERICAN
GAS LIGHT JOURNAL

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THURSDAY, MARCH 2, 1882.

Patents.

252,692. Gas lamp.—C. W. Muchall.
252,709. Drop-light chandelier.—John Trigge.
252,787, Preparing gas for preserving food.—E. R. McCall.
252,848. Electrical gas burner.—J. Redding.
252,849. Electrical gas lighting.—J. Redding.
252,967. Apparatus for the manufacture of gas.—J. S. Pierson.
252,981. Distillation of coal tar.—G. C. Trewby and H. W. Fenner.
253,028. Gas machine.—R. W. Flower, Jr., and E. C. Burgess.
253,120. Apparatus for manufacturing gas.—T. G. Springer.
253,406. Gas engine.—Thos. McAdoo.
253,499. Gas cook stove.—J. H. Bean.
253,709. Gas engine.—R. Hutchinson.
253,767. Gas stove.—Charlotte Rupert.

REISSUES.

10,032. Process of and apparatus for the manufacture of gas.—T. G. Springer.

Explosion of a Street Lamp.

The residents of Jersey City Heights, on Harrison avenue, near Monticello avenue, were startled this morning by a loud report. The explosion proved to be the bursting of an oil lamp used in lighting the street. The oil burned brightly and created no little confusion among the residents of the neighborhood. The fire was extinguished without doing serious damage.—New York *Telegram*, Feb. 24.

The Gas Killed Him.

Wells Brainard, of Gainesville, a wealthy farmer quite well known in this section, died at his home last night. Mr. Brainard was the gentleman unfortunate enough to be asphyxiated as a result of blowing out the gas upon retiring at the Clinton Hotel, in Rochester, recently. He was sixty-eight years of age, and a gentleman highly esteemed by all who knew him.—*Exchange.*

Gas Tar Water for Insects.

Gas tar water is said to be sure death to potato bugs. A farmer in New York has for two years past used on his potato vines water which had been impregnated with gas tar.

Put two quarts of gas tar in a pail, and fill the pail with water; stir it up well and let the tar settle. Then sprinkle the vines with the water from a sprinkling pot. This has proven more effective than Paris green. He has also tried it on current bushes, and finds it equally effective. It is inexpensive and perfectly reliable, and no doubt will prove equally sure death to insects of every kind on trees. This gas tar can be had for one dollar a barrel, and one barrel would supply a whole township.—Ohio *State Journal.*

Street Lighting by Gas in London.

With a view of showing the maximum power that can be obtained from gas in our public streets, D. Hulett & Co., of High Halborn, have just fitted six lamps on each side of a section of Holborn with Siemens' patent burners, and at the "rest" opposite Gray's Inn Road a massive lamp post surmounted with a 44-inch octagonal lantern, fitted with a large burner of the same patent, giving a light of 280-candle power at a consumption of 55 cubic feet per hour, has also been placed. As this section will be in close juxtaposition to the electric light, an opportunity of contrasting the two methods of lighting will be afforded.—*Ironmonger.*

Quinine for Prevention of Sunstroke.

Though somewhat out of season, we think it worth while to enter for preservation the means of prevention of sunstroke recommended by an English surgeon. He says:

For seven years of residence in Central China, upon the banks of the Yang-tse-kiang, which annually overflows its banks, I found nothing so protective against sunstroke as ten grains of sulphate of quinine suspended in a wineglassful of sherry, and taken before going out at midday, when required to brave the sun heat, which is oftener above than below Calcutta temperature. I have tried this plan in so many cases that I feel certain that quinine is as prophylactic against sunstroke as against malarial fever. It was while endeavoring to neutralize the miasma which causes the latter that I noticed how completely I felt braced against the effect of the sun heat. I should be inclined to dissolve the quinine in hydrobromic acid instead of the sherry.—*Med. and Surg. Reporter.*

Sulphate of Ammonia.

LIVERPOOL, Feb. 4.—The position of the market has not altered materially. The tone remains firm, and quotations at £21 f.o.b. Hull. The available quantity in the country is small, but the demand is equally insignificant. The future course of prices will be more or less affected by the expected orders from the Continent; but the inclination of buyers is still to look on. Locally, a better trade doing; quotations, £20 17s. 6d. to £21. Good grey in London quoted at £20 17s. 6d. —*Journal of Gas Lighting.*

GAS STOVES ON RENTAL.—The Dudley (Eng.) Gas Company have commenced to supply gas stoves, at a moderate rental, to those of their customers who are willing to give them a trial for cooking or heating The company put the stoves in place free of charge.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
34 PINE STREET, NEW YORK CITY.

MARCH 2, 1882.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	*Par.*	*Bid.*	*Asked*
Gas Co.'s of N. Y. City.				
Central	$466,000	50	70	75
Harlem	1,800,000	50	92	94
" Bonds	170,000			103
Manhattan	4,000,000	50	225	230
Metropolitan	2,500,000	100	160	165
" Bonds	658,000	...	107	110
Mutual	5,000,000	100	96	98
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	190	195
" Bonds	750,000		106	110
New York	4,000,000	100	118	120
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	108	112
Citizens	1,200,000	20	58	60
" S. F. Bonds.	320,000	1000	105	109
Fulton Municipal	1,500,000	100	75	80
Peoples	1,000,000	10	25	30
" Bonds.	290,000	.	101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	60	64
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	60	65
" Bonds	1,000,000	...	98	103
Richmond Co., S. I.	300,000	50	70	75
" Bonds	40,000	—	—	—
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			38	39
Bonds			107	—
East Boston, Mass	220,000	25	122	128
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Jersey City	750,000	20	155	160
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	159	160
New Haven, Conn		25	132	—
Oakland, Cal			32	33
Peoples, Jersey City		...	75	80
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y		50	70	80
" Citizens		100	30	35
Wilmington, Del.		50	174	...
Yonkers		50	30	32
St. Louis Missouri	600,000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			68	69
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C	1,500,000	20	185	200
" Scrip	375,000	15	200	205

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Adopted in Europe by Gas Companies producing 200,000,000 cubic feet of gas daily, and in America by the Gas Companies at Quebec, Ca.; Newport, R. I.; Williamsburgh N.Y.; Citizens, Newark, N. J.; Baltimore, Md.; St. Joseph, Mo., and Allegheny, Pa.

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"The working is entirely satisfactory; 16-oz. liquor is made. I shall be happy to show it or answer inquiries."—A. A. Smalley, Newark, New Jersey.

"The best evidence of what I think of it is that I have recommended our Board to purchase one and have it erected in our works during the coming summer."—John H. McElroy, Pittsburgh, Pa.

"Most efficient instrument I know for extracting ammonia from gas. Produced 36-oz. am. liq. and gas free from ammonia.—Robert Morton, London Gas Light Company.

"I was at Beckton last week. Four of the six "Standards" were at work, and the other two shortly to be put in use, as the make increases; *while ten tall tower-scrubbers stand idle alongside.*—Letter from London, Oct. 25, 1881.

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SOLE AGENT FOR THE WESTERN HEMISPHERE.

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It has about two and a half miles of mains already in use through the heart of the city of Yonkers, and is supplying gas for cooking, heating, and various industrial purposes.

The problem of a purely fuel gas is at length practically solved, and is a complete success. That it must speedily go into universal use is apparent to everyone.

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R. W. VAN PELT, *President of the Company,*
And also President of the Yonkers Fuel Gas Co., and of the Westchester Gas Light Co.

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Several Gas Works Anywhere in the United States,

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Companies not paying dividends, or who are about to rebuild or enlarge their works, and do not wish to make assessments for improving, will find it to their interest to communicate with us before expending money for repairs or improvements.

Call or address, with some particulars, such as average consumption of gas, the selling price to consumers, holder capacity, size and length of street mains, etc.,

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AS SUPERINTENDENT OF GAS WORKS.

Has had 15 years' experience; thoroughly understands the business in all its departments—the construction of gas works, manufacture of gas, laying of street mains, inspection of gas fittings, or is a practical gas fitter. Can make own drawings of works, and thoroughly understands and can perform the secretary duties of the office. Can give the highest references if necessary.

542-2t Address "SUPERINTENDENT," Care this Journal.

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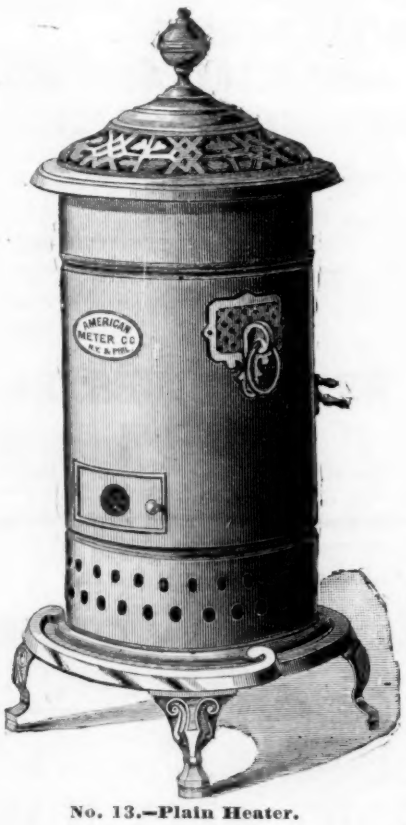
We call attention to our new Catalogue of Heating Stoves, which is now ready, comprising descriptions and illustrations of a varied assortment of Plain and Reflecting Cylinder Stoves, Open Fire-Place Heaters, etc., designed to meet the demands of the approaching season. Gas Companies and others will confer a favor by sending for Catalogue and examining the merits of these Stoves, which we feel assured will give satisfactory results.

AMERICAN METER COMPANY



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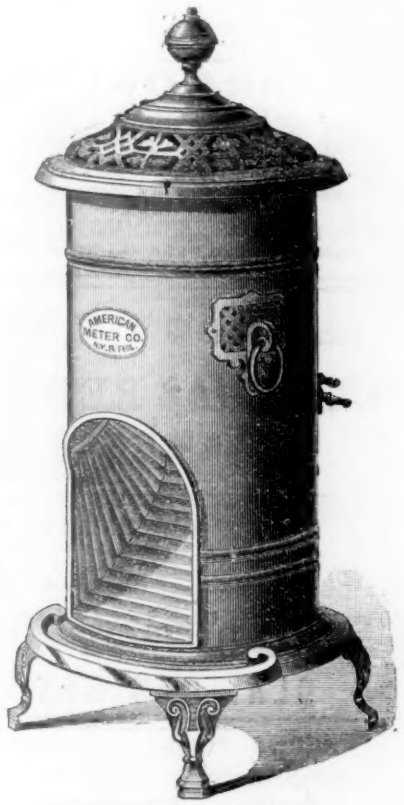

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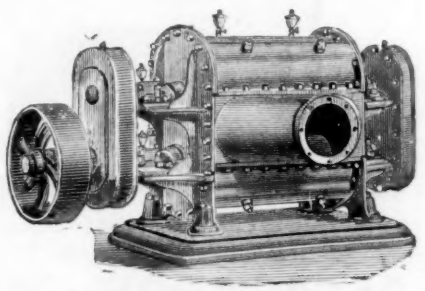

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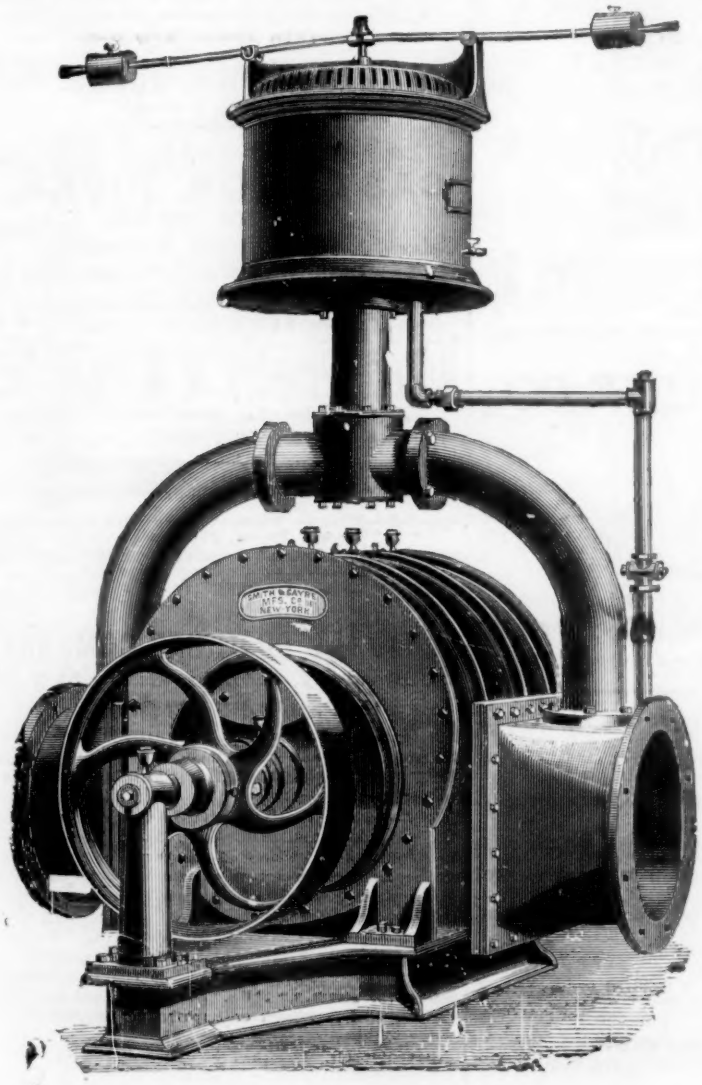

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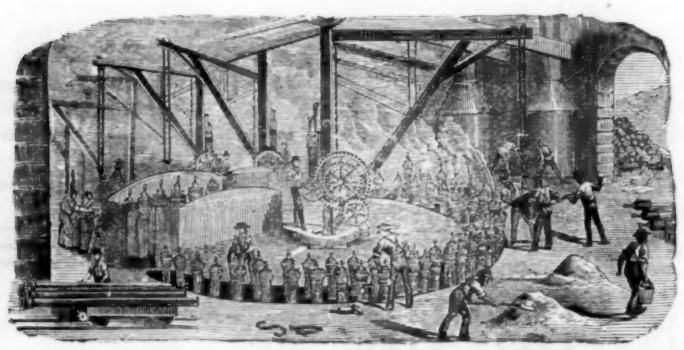

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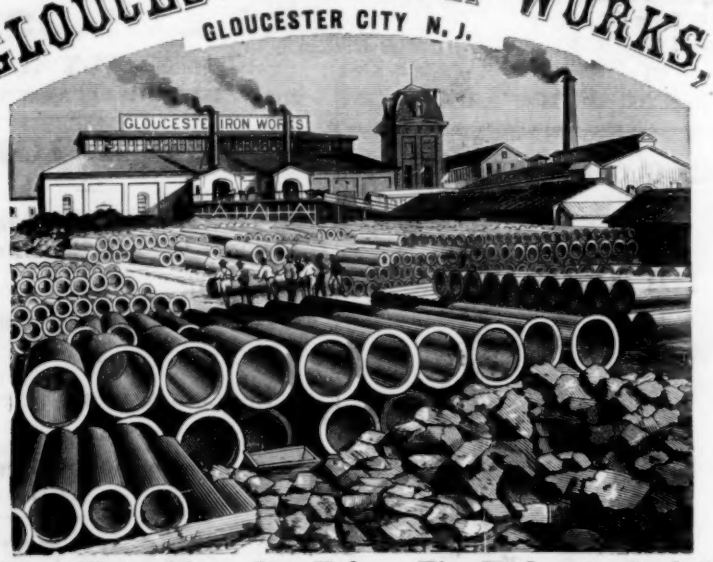

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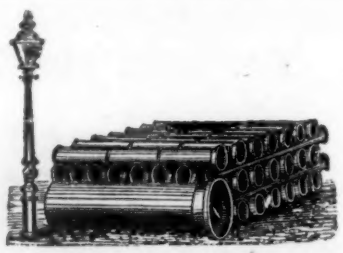

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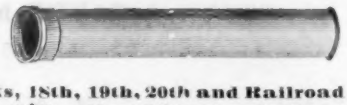

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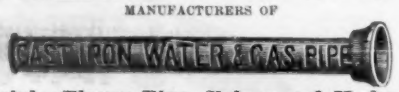

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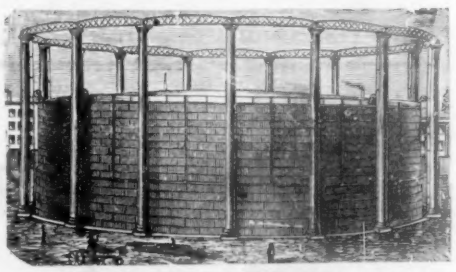

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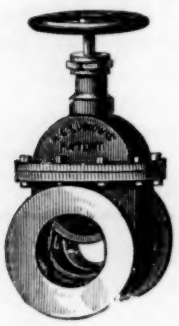

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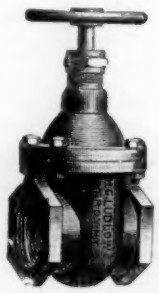

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Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General J. R. HAWLEY, President

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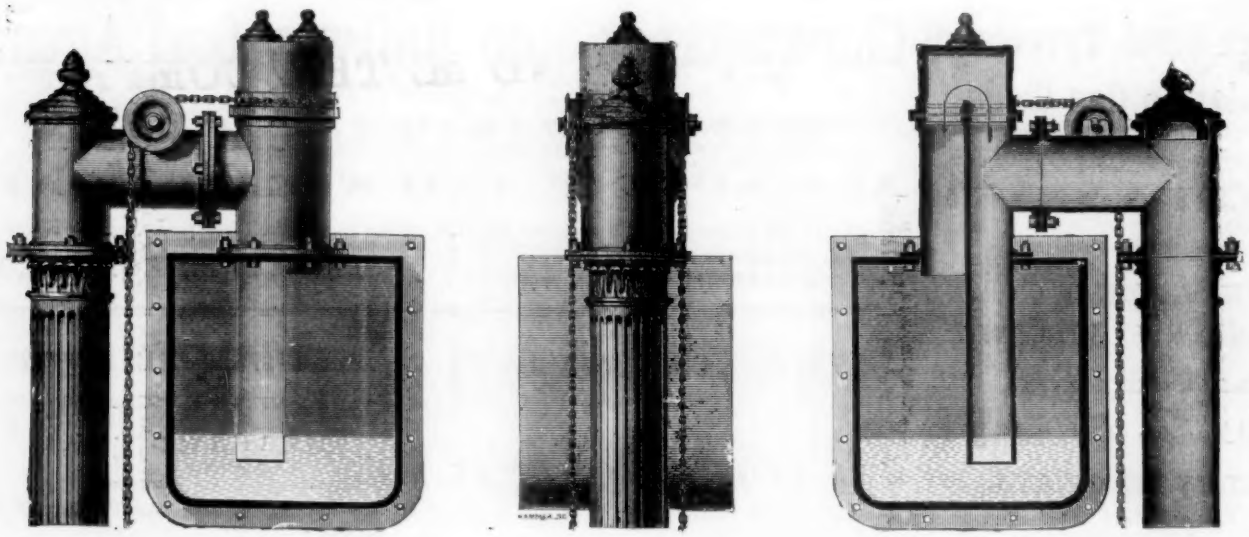

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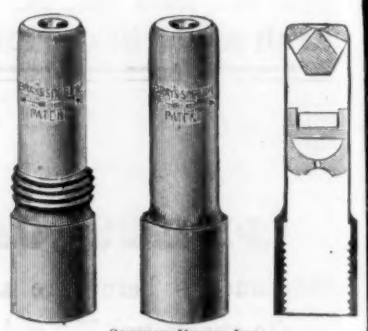

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The Special Burners are made for both High and Low Pressure. In ordering Burners our customers will confer a favor by stating the Pressure.

Bray's Patent Standard Slit-Union Burners do not Corrode in any Atmosphere.

They give a Permanently Well-shaped Flame, free from Roaring and Flickering.

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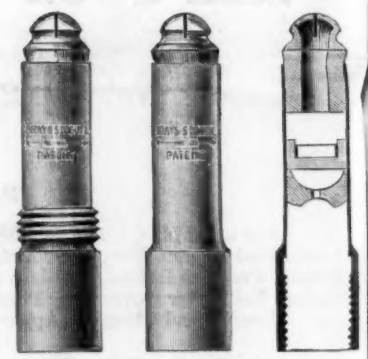

SPECIAL SLIT-UNION.

The "Special" Burners, as improved, are more adaptable to the requirements of gas illumination than any now before the public. They can be made to suit any pressure or quality of gas (including air gas). The gas inlet is so placed that it cannot be tampered with, and they are not liable to get out of order.

The following table and sentences in quotation marks are taken from the report of S. C. Ford, the United States Inspector of Gas and Meters at Washington, D. C., for the year 1881:

Description of Burner.	Pressure at points of ignition.	Actual consumption of gas per hour.	Illuminating power in candles at rate of actual consumption.	Illuminating power in candles, at rate of 5 cu. ft. per hour.	Value of one foot of gas in terms of standard candles.
	Inches.	Cubic Feet.	Candles.	Candles.	Candles.
Bray's Standard Slit-Union (30 candles....	.255	6.90	30.04	21.76	4.35
" Special Slit-Union No. 7.....	.50	4.74	19.20	20.25	4.05
" " " No. 6.....	.50	4.10	16.61	20.25	4.05
" " " No. 5.....	.50	4.24	16.97	20.01	4.00
" " " No. 4.....	.60	3.49	12.58	18.02	3.60
" " Union Jet No. 7.....	.50	4.84	19.13	19.76	3.95
" " " No. 6.....	.55	4.32	17.10	19.79	3.95
" " " No. 5.....	.60	4.14	15.65	18.90	3.78
" " " No. 4.....	.55	3.38	12.04	17.81	3.56
" Regulator Union Jet No. 7.....	.50	4.99	17.69	17.72	3.54
" " " No. 6.....	.50	5.18	17.63	17.01	3.40
" " " No. 5.....	.60	4.37	13.71	15.68	3.13
" " " No. 4.....	.60	3.97	11.46	14.43	2.88

"On examination of the above table of tests, made with various burners, it will be observed that the illuminating power obtained with Bray's special burners Nos. 5, 6, and 7, both slit-union and jet form, was high; but with Bray's regulator burners only moderately good."

"The result of test with Bray's standard slit-union burner was highly satisfactory. This burner is best suited for street illumination, and will yield the maximum power obtainable from a cubic foot of gas."

"The special burners manufactured by Bray & Co. compare favorably with any yet inspected by this office. They are well made, and no doubt will prove very durable in practical use. They are best adapted for gases of high gravity."

Bray's Patent Standard Slit-Union Burners are of 30, 40, 50, 60, 70, and 80 candle power. The Patent Lanterns are adapted for burners of 50, 80, 100, 200, 300, 400, and 800 candle power, and are acknowledged to be the best lantern for street lighting yet invented. Price Lists and Circulars furnished on application.

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